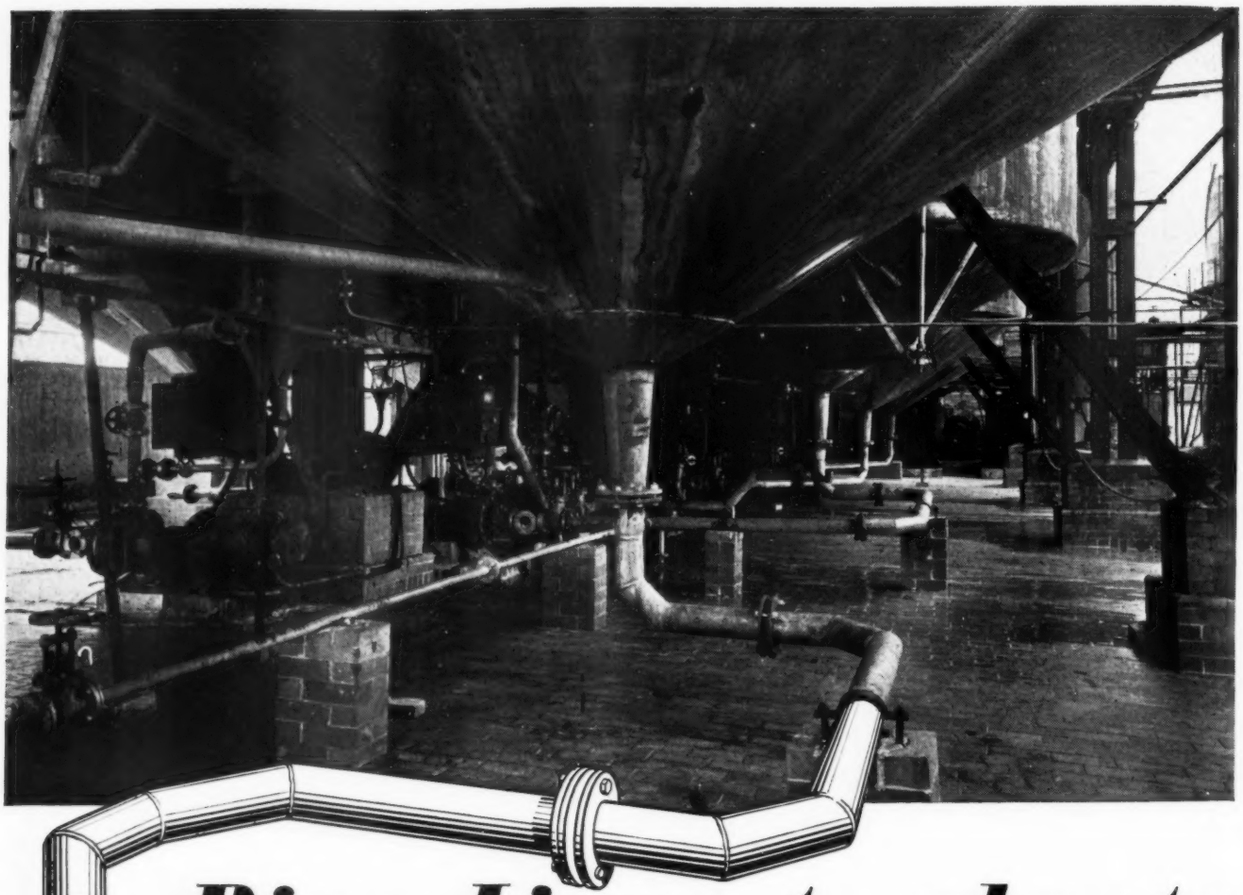
WORLD CROPS

THEIR CULTIVATION, PROTECTION, STORAGE, HANDLING AND PROCESSING FOR FOOD, FODDER, AND INDUSTRIAL PRODUCTS

VOLUME 2, No. 7 JULY 1950

A Publication of The Leonard Hill Technical Group



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WORLD CROPS

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THIS MONTH'S COVER

A spectacular example of gullying, the last stage in erosion, in Georgia, U.S.A. In this issue there is an article on Soil Conservation in the British Colonies (p. 305), where gullying on the same spectacular scale is not unknown.

(Photo: United States Inf. Service)

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Editorial Comment

The Sudan Gezira in retrospect

THE termination on June 30 of the concession granted by the Sudan Government to the Sudan Plantations Syndicate and the associated Kassala Cotton Company is an event of more than ordinary interest.

The association between the Sudan Government and these two companies has existed for 25 years; it has brought prosperity to the country and is an outstanding, one might almost say unique, example of development of a highly-specialised agriculture among a community of peasant farmers originally backward and uneducated, employing modern methods and making full use of scientific research.

Inaugurated in 1926, when the dam at Sennar on the Blue Nile was completed, the scheme had for its primary object the cultivation under irrigation of Egyptian-type long-staple cotton in the Sudan Gezira—the area lying between the confluence of the White and the Blue Nile to the south of Khartoum—the suitability of the crop for cultivation under these conditions having been ascertained by a lengthy series of preliminary experiments.

The scheme covers some 800,000 feddans,* divided up into lots of 40 feddans each, on which peasant cultivators were settled as rent-paying tenants, a condition of tenure being that they worked their lands in accordance with instructions issued by the authorities.

The Syndicate had a paid-up share capital of £4,500,000, and undertook the general agricultural management of the undertaking. It provided staff, buildings and machinery, collected, ginned and marketed the cotton crop and made advances to the tenantry.

The Government maintained and operated the irrigation works and provided the research facilities.

Upon the tenants devolved the planting, cultivating and harvesting of the crops grown. After deducting joint expenses the net proceeds of the cotton crop were divided between the Government, the tenants and the Syndicate in the proportion of 40% each to the Government and the tenants and 20% to the Syndicate.

An eight-course rotation comprising cotton, dura (sorghum) lubia (*Dolichos lablab*—a leguminous fodder crop) and bare fallow was evolved; the effect was that each year half the total area was under bare fallow while the remainder was about equally divided between cotton and food and fodder crops; it has proved very successful.

In the earlier years a succession of bad seasons, pests and diseases, low yields and low prices gave cause for anxiety. Research has enabled the disease problems to be largely overcome and yields improved by breeding better disease-resistant strains of cotton while the price situation has also markedly improved.

The present situation is very sound. The Sudan Government have defrayed all current and recurrent expenses and a surplus exceeding £E6 millions has accrued to revenue. The Syndicate after meeting all expenses and taxation have paid satisfactory dividends, while the tenants, although figures are to some extent conjectural, are certainly far better off than peasant cultivators in almost any similarly situated area; it has been estimated that an industrious tenant can make from his holding at present prices an annual net income of £335 p.a.

It is only 53 years since the conclusion of the Sudan Campaign rescued the country from the welter of savage anarchy into which it had lapsed after the fall of Khartoum in 1884, and to its present prosperity the scheme has made a major contribution. It must in consequence be regarded as an outstanding achievement of British administration.

The changing conditions

Nevertheless the scheme has not been without its critics, the main point of criticism being of course that large sums have been absorbed in the payment of dividends to the Syndicate's shareholders.

It can be conceded that in all probability the present satisfactory position could not have been attained, at least so soon and so smoothly, had not the experience, business ability and technical skill which the Syndicate could command been available at the outset. Nevertheless now that the initial difficulties have been satisfactorily surmounted, it is considered that the functions previously performed by the Syndicate should be taken over by a Government-sponsored, non-profit making organisation, thereby enabling the share in the profits which formerly accrued to the Syndicate and its shareholders to be applied to the benefit of the cultivators and Sudanese taxpayers generally. Such an eventuality was of course contemplated when the scheme was first launched and the termination of the original contractual period with the Syndicate provides the appropriate opportunity for making the change.

Under the new arrangements the functions hitherto performed by the Syndicate will be transferred to a Board of seven, comprising a Managing Director, two officials of the Sudan Government,

*1 feddan = 1.04 acres.

and four others nominated by the Governor of which three will be Sudanese. The Board will be assisted by a local advisory committee and it will be responsible to the Sudanese Executive Council and through them to the Sudanese Legislative Assembly. It is stated that the aim and intention is to devolve full responsibility for the management of the scheme on to the Sudanese as quickly as possible.

The Sudan Government will provide capital to enable the Board to take over the existing undertakings from the Syndicate and will advance funds required for working expenses; on both, interest will be charged. They will also continue to bear the cost of the Irrigation Department but the cost of research will become a charge on the scheme. In addition the Board will also be required to promote social welfare measures in the scheme. The proceeds will be divided between the Government and the Board in the same proportion as hitherto; of the 20% formerly taken by the Company a part will be allocated to research and social services and any surplus divided between the Government, the tenants and the Board.

The prospect

Only time can show how the new organisation will work; certainly all will wish it every success but the responsibilities will be heavy, for not only will it have to shoulder the whole of the services previously performed by the Syndicate but it will also have to undertake not inconsiderable additional duties. It is accepted in principle that the Board must be kept aloof from political controversy and must retain in full measure the active interest, confidence and support of all the people in the scheme. This is of course essential but it may not always be easy when control is wholly local. The Board will have the great advantage of taking over an undertaking that is functioning with great efficiency, and they will be saved many of the problems and perplexities which confronted the scheme at the outset. On the other hand, new problems can arise at any time and for their solution there must continue to be available that combination of business and administrative efficiency and scientific resources upon which the past has been built.

Moreover many, if not all, the tenantry will continue for long to require a vigorous hand behind them to ensure that the cultural operations continue to be properly performed at the proper time, combined with authoritative but sympathetic direction to which they can turn for advice and information in times of doubt or difficulty.

If all this is forthcoming the scheme in its new guise will have little to fear and it may well be that the future can hold in store for it successes which will equal and even outshine the great achievements of the past.

British farmers reassured

THE Minister of Agriculture has given British farmers a reassurance of guaranteed prices and markets which, it is hoped, will allay the concern aroused when the late Parliamentary Secretary to the Ministry of Food made a speech, criticising the policy of guaranteed prices and assured markets.

It is only too easy for those who are not *au fait* with agricultural industry, particularly in an industrial country like Britain, to form preconceived ideas about how the farmer earns his living and criticise the seemingly vast sums of money which are devoted to maintaining guaranteed prices. The fact of the matter is that the prices have in the main been below world prices and the Ministry of Food has paid the farmer less for his grain than for the imported commodity. The old cry for cheap imported food has no longer the justification it may have had in the 'thirties, particularly as so much of our imported grain comes from the dollar area and the dollar gap is still far from closed.

Before the war the industry was at a low ebb, the average farmer having only a few pounds a week on which to live after meeting his working expenses. Today the total farm capital of the country is nearly £1,000,000,000—an increase of £650,000,000 over pre-war which has come largely from farmers' much-criticised net profits.

The farmer and farm worker belong to one of the hardest-working sections of the community; particularly the farmer, who is on duty for at least twelve hours a day and seven days a week. He is a man of many parts—more so than ever these days—and at all times has to contend with the weather, an immeasurable risk which most other industries do not have to bear.

The policy of the Agriculture Act of 1947 forms a basis on which the farmer can plan his business with confidence. With this behind him there is encouragement to maintain and improve the level of efficiency and to him the comforting words of the Minister that the Government do not intend to go back on their promises will be most welcome.

The N.I.A.E.

ON another page of this issue we publish an illustrated account of the first open day given by the National Institute of Agricultural Engineering at Wrest Park in Bedfordshire. Many readers of WORLD CROPS may be aware of the work of this organisation, but for those who are not we commend the brief account that is given to their careful attention.

The existence of an organisation which on the one hand assists the development of new agricultural machinery by research and on the other hand

carries out independent tests of machines actually on the market is an invaluable asset to agricultural industry, while its information services and the liaison which it provides with the National Agricultural Advisory Services are a means for rapidly disseminating available information. Nor is this all, for the Institute also provides facilities for supplying information to overseas dependencies.

The display itself was admirably arranged and as perfect as anything we have seen in a not inconsiderable experience of organisations and institutions. The services it provides are undoubtedly a great national asset, the value of which should be increasingly appreciated as time elapses.

Organic fertilisers

A RECENT conference of the Organic Fertilisers Association held in Maidstone last month, as well as two articles which appear elsewhere in our current issue, attract attention once more to the perennial subject of organic matter in the soil and the part it plays in soil economy. Every one admits that the still somewhat mysterious substance known as humus exercises an important influence both on the physical condition of the soil and on the biological changes that go on therein; the story is, however, very far from complete and there are still many gaps in our knowledge of the relationships which exist between different aspects.

Chemists and microbiologists busily work away with ant-like industry, investigating this and that aspect of the question; new facts emerge and are related to other facts, but they often remain unconnected with other and more remote observations by physicists and with those of agronomists and practising farmers in the field, notwithstanding that they all form part of a vast connected picture. Alongside them, but nevertheless separated by a great gulf, is the select but by no means unvocal band of ultra organic enthusiasts, who loudly proclaim their faith in the esoteric virtues of organic manures and make up for any slight lack of scientific evidence by the fervour of their protestations.

Meantime, the farmer wants to know whether the alleged superior value of organic fertilisers really does justify him in paying a somewhat higher price per unit of fertilising element contained in them than he would have to do if he bought it in the form of artificials, while the manure compounder and the manure merchant must often wish that they had a bit more definite and concrete information to go upon.

The present position, in fact, irresistibly reminds one of a number of jigsaw puzzles addicts grouped round a large table and endeavouring to reconstruct sections of the picture out of the innumerable bits and pieces. Oft-times it happens that a casual passer-by may pause awhile and suggest a grouping of sections that may not have been apparent to those already engaged in the task. Ultimately a complete picture emerges.

No doubt this will also happen in due time in connection with the great problem of soil organic matter, but in the meantime it does seem that progress is somewhat slow. After all, there is good reason to believe that the nature and functions of organic matter in the soil are inextricably interwoven with the maintenance of fertility and hence with the continued existence of the human race. In consequence it seems worthy to be ranked as one of the major scientific conundrums confronting mankind and to be treated accordingly. Is it too much to hope that this will become recognised and that ultimately there will be a combined and concerted attack on the problem, not only from a national but also from an international standpoint enlisting the co-operation of the best scientific brains and experience available? It might also be borne in mind that oft-times the scientific observer not previously connected with the subject may be able to make an enlightening contribution to its ultimate solution.

The Grand Coulee Dam

THE dedication of the Grand Coulee Dam on the Columbia River in Washington State by President Truman on May 11 marked another stage in the great programme of development in the U.S.A., which took its rise in the years of depression. The dam will provide water for irrigating 1,029,000 acres of semi-arid land in South Central Washington while the electric turbo generators of the scheme are the most powerful ever built and are capable of carrying loads approaching 130,000 kilowatts.

The reservoir formed by the dam is a lake which stretches 150 miles northward to the Canadian border and has appropriately been named Lake Franklin D. Roosevelt. The region covered by the scheme is one of the potentially richest in the U.S.A. since not only are there vast areas capable of agricultural development but also 40% of America's known phosphate reserves are located there. The Columbia River rises in Canada and the full development of the scheme demands, if it is to reach full fruition, collaboration not only between the various U.S.A. state and federal authorities but also with the Canadian Government. Proposals for the formation of a Columbia River Authority on the lines of the highly successful Tennessee Valley Authority have been laid before Congress by the President. Their fruition would provide another example of that type of interstate and international collaboration which could be so advantageously applied to the development of some of the great river systems of other continents, notably those of Africa and South America.

The Importance of Humus in Assam Tea Estates

Experience and Experiment Over a Century of Planting

C. R. HARLER

Tea Research Officer, Nyasaland

The development of manuring as practised on the tea estates of Assam is described and discussed in the following article, and the beneficial effects of leguminous shade trees are emphasised. The author worked for many years at Tocklai in Assam at the research station of the Indian Tea Association.

Unshaded tea in Assam

TEA was discovered in Assam by Robert Bruce in 1823, and the first tea estate was established by British enterprise in 1838. Expansion rapidly followed and by 1860 the Indian tea industry had been established and the pioneering days were over, although difficult times still lay ahead. Today in North East India, which includes Assam, the northern fringe of West Bengal and Eastern Pakistan, there are about 1,400 estates covering 650,000 planted acres and producing over 500 million lb. of made tea annually.

The yield of tea per acre in 1860 was 3 to 4 maunds* of tea (240 to 320 lb.), but this has since steadily increased so that now unmanured, unshaded tea will give 8 to 10 md. per acre. This increase is due to better planting material, improvements in pruning and plucking and in general field methods. With suitable additions of fertilisers or with the help of shade trees, 15 md. tea (1,200 lb.) per acre is harvested on many estates whilst a number average as much as 20 md.

Early recognition of the value of organic matter

The pioneer planters in Assam soon appreciated that when the soil is exposed to the sun and rain it deteriorates in fertility and texture, but that both are conserved and enhanced by additions of organic matter. In 1870 William Roberts of the Jorehaut Company* in a letter to his manager mentioned the value of composts, vegetable matter, weeds, etc., in improving tea seeds, and added that with their use there would be no need to buy bones, oilcakes or artificial manures. He also advocated the addition of top soil from nullahs and small streams to the fields of tea estates.

In 1880, Buckingham, an Assam planter, described the 'tea fertilising tree,' as he called the sau (*Albizzia stipulata*), a leguminous tree indigenous to Assam. He claimed that tea grown under this tree became more vigorous and increased its yield. Other trees were later used for the same purpose, including *A. Lebbec*, *A. procera*, *Dalbergia assamica*, *D. sissu* and *Derris robusta*.

Before 1900 semi-permanent green crops were also being tried, including Boga medeloa (*Tephrosia candida*) and Rahar (*Cajanus indicus*). Eight-week green crops like Dhaincha (*Sesbania arcuata*) and Cowpeas (*Vigna catjang*) soon followed.

About 1900, oilcakes, phosphates and artificials were tentatively essayed, dressings of the order of 8 md. (640 lb.) cake and 4 md. (320 lb.) phosphates per acre being employed. The war years, 1914-1918, witnessed a slowing up in the use of this type of manure, but after the war scientific experiment showed the way to a complete change in the manurial treatment and management of tea soils.

Intense scientific study of tea soils begins, 1920

Before 1920 the systematic manuring of tea in Assam was not generally practised, and any manure available was added where the planter considered the tea needed it most, whilst bulky manures were usually applied to patches situated near the source of supply. In 1920 the Scientific Department of the Indian Tea Association at Tocklai drew up a plan for a five-year manuring cycle based on the experience then available, the details of which are set out below:

Year I.—Apply a dressing of 5 to 10 md. (400 to 800 lb.) of crushed limestone per acre.

Year II.—Plant semi-permanent green crop like Boga medeloa or Arhar between alternate lines of tea. Bury Arhar at end of season.

* 1 maund = 80 lb.

* *A History of the Jorehaut Tea Co. Ltd.*, by H. A. Antrobus, p. 349.

Year III.—Apply a mixture of sulphate of ammonia, muriate of potash and superphosphate, giving N P K=30/30/30 lb. per acre. Bury Boga medeloa at end of season.

Year IV.—Plant eight-week green crop between tea rows in spring, cut and bury in June.

Year V.—Apply the same mixture as in the third year.

This cycle aimed at keeping the soil sweet, adding plenty of organic matter as green crops, and replacing the minerals taken from the soil by the tea. At the same time a large number of manurial experiments were designed and laid out at Tocklai.

Artificial fertilisers supreme, 1925-1935

One of the early experiments was designed to study the effect of lime on tea. The tea soils of Assam are markedly acid with a pH value of about 5.4, but it was soon observed that small doses of lime did no good to tea whilst doses of about 20 md. or more were clearly harmful. Accordingly, in 1923 the use of lime was omitted from the five-year cycle.

It was next shown that the eight-week green crop gave practically no increase in the yield of tea. During the growth of such green crops and immediately after burial the yield of tea was depressed, and often barely made up for the early loss in yield by the end of the season. The Assam soils become rich in nitrates when the spring rains fall on the warm earth and it seems probable that Cowpeas and Dhaincha feed on these nitrates and fix little nitrogen from the air. As a result, the eight-week green manure crop fell into disuse.

During the same period a change in plucking procedure was also taking place and a flat plucking table was adopted in place of the conical one formerly employed. As a result more crop was made and the spread of the bush completely covered the soil, a fact which made the growth of semi-permanent green crops difficult and unprofitable. Thus lime dressing, the eight-week and the semi-permanent green crop all disappeared from the manuring cycle, and in place of these a dressing of artificial fertilisers was given.

Experiments with nitrogenous manures were now in full swing and it soon became clear that sulphate of ammonia was easily the best of the lot, for it not only gave better returns than the others but it also maintained a high soil acidity in which the tea bush thrived. Each lb. of nitrogen added as sulphate of ammonia annually gives about 2 lb. extra tea in the first year, 4 lb. in the second, 6 lb. in the third and 8 lb. in the fourth year, the increase being maintained, provided annual applications of fertiliser are given. The dose was soon raised to 40 lb. nitrogen which pushed up the yield by about 320 lb. tea per acre.

It was also shown that 60 lb. and 80 lb. doses of nitrogen give proportional increases, although above the last figure the law of diminishing returns comes into action, and 120 lb. nitrogen gives only about $2\frac{3}{4}$ times the increase shown by 40 lb. On many estates 400 lb. doses of sulphate of ammonia, equal to about 82 lb. nitrogen, are applied nowadays.

Experiments with potash manures showed that although this element has a beneficial effect on young tea, the response from mature tea is not economic, while phosphatic manures were also shown to be not worthwhile. We were thus left with steady annual doses of sulphate of ammonia alone in the place of the all-round manure cycle, based on first principles but not on experiment, which was evolved at the end of World War I.

There were many critics, of course, of the continued use of sulphate of ammonia, some of whom prophesied the eventual ruin of both tea and soil as a result. However, experiments have now been running for 30 years and the tea is still vigorous and high-yielding, the soil humus is more than maintained and the soil itself is in good heart. It must be remembered that a heavy yielding tea bush completely shuts off direct sunlight from the soil and thus prevents the very rapid loss of organic matter which occurs in an exposed tropical soil. At the same time a heavy tea crop connotes bulky prunings which are added to the soil at the end of the season.

The growth of composting, 1930 onwards

About 1930 the critics of artificial fertilisers became very active and the value of composts was stressed.

In South India composting became developed to a high degree, for there is plenty of waste land round the estates, carrying an abundance of scrub jungle and grass. In addition, the estate herds are under control and are housed at night in communal sheds from which dung, soiled bedding and urine earth are available in quantity. Thus the technique of composting on tea estates could be worked out under ideal conditions.

From about 80 compost batteries in South India about 50,000 tons compost were produced annually, employing the Indore process in the dry season and the Lincoln method during the monsoon. The cost was about Rs. 2 (3s.) per ton, but this figure is only a book entry since the labour employed in composting had to be paid in any case and if not at work at the pits it had to be used on non-essential work elsewhere.

Experiment showed that an application of 20 tons of compost per acre gave in three years about as much crop increase as three annual dressings of sulphate of ammonia giving 40 lb. nitrogen per dose, the cost of which was then about Rs. 40, *i.e.* the same as the cost of the compost.

Doubts about composting

Early in this work the writer became worried over the exaggerated claims made by the advocates of composting who were beginning to claim for it impossible properties. To the agricultural scientist nitrates produced from organic matter are identical with those produced from sulphate of ammonia or any other form of 'devil's dust,'

Here the plucked tea leaves are being weighed; note the well-shaded tea in the foreground

Aerial view of well-shaded tea in Upper Assam. The tea bushes can be seen underneath the shade trees

as all fertilisers have come to be designated by fervent composters.

Another point which gave deeper cause for concern was the fact that as scrub jungle is cut and carried off year after year to the compost pits, subsequent jungle growth falls off. Areas near the writer's office in South India (where there was an experimental compost-battery of nine pits) which once carried scrub jungle about 6 ft. high, bore only coarse grass after four years of cropping, and it soon became apparent that it was necessary either to go further afield for organic matter, thus increasing costs, or to manure the scrub jungle. But manure with what? 'Devil's dust'? Another possibility is to crop an area for two years and then leave it fallow for a year, as we did in England in the Middle Ages, when the pressure of population on the land was not as severe as at present. The conclusion to be drawn is that composting on a grand scale is merely robbing Peter to pay Paul. By all means have a compost pit in your garden or on your allotment, by all means use cattle manure and soiled bedding, but it is impracticable to make compost on a large scale from scrub jungle surrounding the average tea estate in India. Much of the so-called waste land round Assam tea estates will now be needed to grow food for the labour force, so that scrub jungle areas will disappear.

In Assam, where many compost batteries were started, it was first claimed that one of the benefits was that composting cleared up untidy areas. Later on it was realised that such clearing up amounted to spoliation which led to barrenness, and actually meant little further organic matter for the pits.

At Tocklai exhaustive experiments with composts were carried out and here it was concluded that the main benefit was derived from the nitrogen content of the compost. Such nitrogen was found to be about 40% as effective as nitrogen from sulphate of ammonia. It was found to be preferable to supply leafy and twiggy organic material direct to the soil without composting, and in this way 3 tons of cuttings gave about as much crop increase as 30 lb. nitrogen as sulphate of ammonia.

Of recent years it has been claimed that crops grown with the aid of composts are superior in quality to those grown with the aid of artificials, but no reliable evidence has been produced to support such claims and experiments in Assam have failed entirely to confirm this suggestion so far as tea is concerned.

Shade trees in tea estates

It had been known for many years that the growth of leguminous shade trees amongst tea is beneficial but the full extent of the benefit was not realised till recently. As long ago as 1905 a few casual weighments showed that tea bushes grown under shade trees gave about twice as much leaf as those grown in the open. At Tocklai Experimental Station the effect of shade had not been studied closely because of the claims of other lines of work, but about 1935 circumstances allowed it to be undertaken and plots under shade trees were established. The results were amazing.

It was shown that while tea which is well tended but unmanured and unshaded will give 8 to 10 md. (640 to 800 lb.) tea per acre in good areas in Assam, with free plucking, a dose of 90 lb. nitrogen per acre given annually will raise the yield to about 18 md., while the same tea will yield about 18 md. if well shaded with mature sau trees (*Albizzia stiputata*) planted 50 ft. x 50 ft. triangularly. This last observation has focused attention on the use of shade trees, for previously it was assumed that the shade effect amounted to 3 or 4 md. tea per acre at the most.

It may now be argued that since good tea unaided will give 9 md. per acre and with fertiliser will give 18 md., why should it not be possible by employing both manure and shade to get 27 md. (2,160 lb.) per acre? It has, however, been found that under leguminous shade the effect of sulphate of ammonia tails off till under very dense shade it is nil. On the other hand, in areas shaded by non-leguminous trees, like *Grevillia robusta*, sulphate of ammonia has its full effect, but the shade effect is not the same as with leguminous trees.

It has been shown that mature sau trees in Assam give about 2 lb. nitrogen a year from leaf droppings whilst their roots provide a similar amount. The nitrogen thus supplied to a well-shaded area may amount to about 120 lb. per acre, and it is possible that thereafter the tea bush, gorged with nitrogen, can assimilate little more. Whatever the explanation, the use and care of shade trees in Assam is increasing and shade is already putting artificial fertilisers at a discount.

A Sau tree planted in a young tea area in Assam grows well and lasts about 25 years. Its successor, necessarily grown in mature tea, lasts perhaps 15 years. Planters nowadays are demanding crops of 15 to 20 md. tea per acre and to maintain such yields tea must be uprooted and replanted after 40 years. In future a policy of shade growth and renewal and the replanting of tea will probably be based on the above periods. When shade is sparse, assistance may be given to the soil by sulphate of ammonia.

Conclusion

The brief account of the manurial treatment of Assam tea soils necessarily omits many details and arguments which have from time to time assumed importance.

Under existing conditions in Assam, in good tea sufficient organic matter is returned to the soil each year to keep it

(*Concluded on page* 286)

The Pineapple Industry of the Hawaiian Islands

A TRIUMPH OF MECHANISATION

PINEAPPLE growing in Hawaii is possibly the most highly mechanised agricultural industry in the world, an industry based on a remarkable soil conservation programme. The author of this new book* shows that this spectacular development has been primarily due to exhaustive research into planting, processing and canning and by careful planning and strict control of both field and factory operations. The report is illustrated by a series of 38 excellent photographs, in the reproduction of which the printer has done less than justice.

The story of this industry is truly sensational and is here unfolded without waste of words by an author with training and experience in pineapple canning, who visited Hawaii to report on this industry to the Malayan Government. The generosity of the Hawaiian canners in facilitating the examination of their methods for the benefit of a rival producer surely indicates, not only generosity to a rival whose industry completely collapsed during the Japanese occupation, but a confidence in the stability of their own achievement.

Mechanisation the keynote

The keynote of the Hawaiian industry is mechanisation; 90% of the operations, both in the field and the factory, are mechanised, hand labour in the field being largely confined to the actual planting operation and the cutting of the ripe fruit, while in the factory it is mainly used in fruit trimming and grading. Mechanisation has been rendered essential by the steep rise in labour costs, the present minimum wage being six times greater than that paid 10 years ago. Capital expenditure on mechanisation has been enormous, but it is still considered economic to spend a thousand pounds of capital to save the work of one man.

Soil conservation

Within the past few years the entire pineapple area has been accurately contoured and terraced for soil conservation.

* *The Pineapple Industry of the Hawaiian Islands.* By F. C. Cooke. Pp. 118. Illustrated. Department of Agriculture, Federation of Malaya, 1949. $5 (Straits currency).

In our February issue there appeared a short article on the pineapple industry in Malaya. The following account of the sister industry in Hawaii, based upon a recently published report, provides an interesting contrast.

Girls grade the fruit and fill the cans. Some pineapple juice is extracted from fruit left over in trimming pineapple —some from the slices themselves

The terraces so formed are broad enough to carry heavy machinery and they are at no point more than 100 ft. apart. The land lying between the terraces is divided into blocks of suitable size by bisecting roads. This work was carried out at a cost of about £1,000,000 for the installation of roughly 4,000 miles of road terraces on 63,000 acres of land.

The crop occupies the land for four years, during which period 40 to 70 tons per acre of pineapples may be obtained, although the overall annual yield is estimated to be between 12 and 13 tons per acre.

After preparation of the land a machine simultaneously fertilises and fumigates the soil and lays and anchors a paper mulch, designed to maintain soil moisture and temperature, retain the fertiliser, seal the fumigant in the soil and thus prolong its effectiveness and suppress weed growth. It is claimed that there is a 20% increase of crop as a result of using paper mulch. The actual planting is performed by hand, but subsequent operations are effected by means of a mechanical cultivator fitted with weed sprays, soil fumigant injectors or fertiliser tubes. Boom sprayers, operated from the terraces, extend to 50 ft. and therefore cover a whole block in two straight runs. These are used to spray not only diesel oil, but also mealy bug mixtures, liquid fertilisers, ferrous sulphate solution and hormones.

The continuous cultivation of pineapples over many years without rotations has necessitated very great care in the cultivation and manuring of the soil before planting, and major, minor and trace element deficiencies are corrected with great exactitude. The fertiliser programme is based on analysis of the leaf bases of the pineapple plants (not on the soil) during the period two to five months after planting, and the fertilisers, either dissolved and blended, are applied together in liquid form, using the boom sprayer, or applied in powdered form directly to the base of the plants.

Harvesting and transport

Harvesting is largely mechanised with the boom harvester. The pickers walk behind a 50-ft. conveyor belt boom which delivers the fruit into a double-tiered bin. When full, four jacks lift the harvester and the lorry drives away. In the peak of the season central control is established by telephone from a tower on a high point, lorries being thereby directed to where they are needed.

Processing

Pineapples arrive at the factory by a conveyor system and are successively mechanically graded for size, washed and diverted to one of several processing lines arranged in parallel. They then pass on

rapidly through a system of chutes, belts and conveyors and are peeled, cored, topped and tailed; the resulting fruit cylinder is trimmed and sliced and finally the slices are graded and put into cans. All this is mechanised and takes just over one minute. In the next minute the cans of fruit are vacuumised and closed. Then, by cooking under pressure, the product is pasteurised in eight minutes, and the process is completed by cooling the hot can for five minutes. Thus a single pineapple passes through the entire processing operation in about 15 minutes. A record day's pack at one factory was 5,600 tons of fruit, over 2,500,000 fruits being converted into 240,000 cases of canned fruit and juice. The largest factory has a total covered floor space of 37¼ acres. Factory messengers and foremen use motor scooters, and these, together with electric trucks and haulers, present a traffic problem. There is, however, little movement of staff and employees within the factory, since mechanical aids, such as loudspeakers and telephones, are used wherever possible.

While the main product from the factory is cut canned fruit, there is a small trade in fresh pineapples and a growing trade in frozen fresh pineapple prepared by the new process of quick freezing at low temperatures. Dried and candied pineapple are subsidiary products, while the sale of pineapple juice has increased enormously in recent years.

By-products

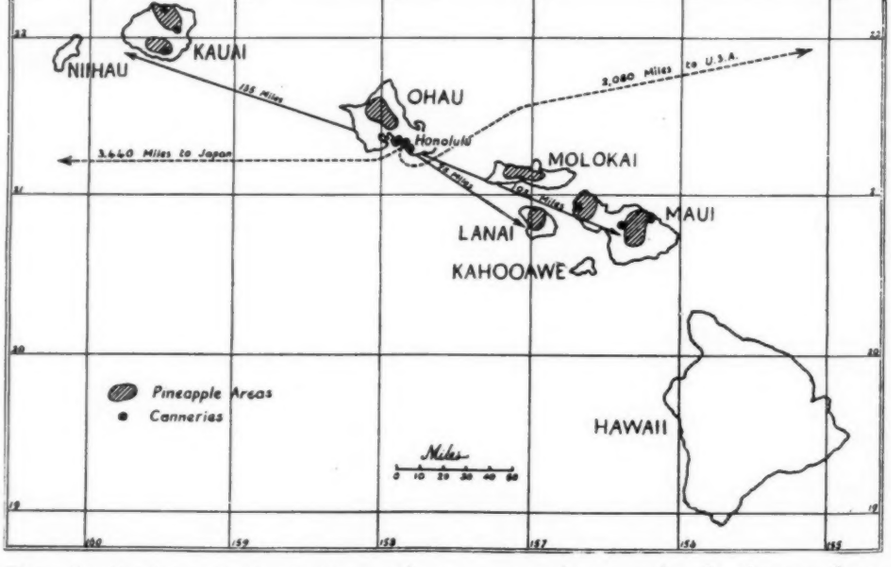
The residue of canning—the shells, tops, cores and trimmings, which normally constitute over 80% of the fruit and were formerly regarded as waste and disposed of at considerable cost—is today profitably utilised, nothing being discarded. Machines have been invented to recover a greater weight of the fruit and a further quantity is mechanically scraped from the skin. The resultant pulp is used for the production of crush and juice, while the green skin is converted into silage for cattle or into pineapple bran. A process has been evolved whereby the equivalent of 4,000 tons of cane sugar are annually recovered by the Hawaiian canners from skin juices in the form of a sugar solution which is used as a canning syrup.

Research

Research has played an important part in the improvement of the Hawaiian canning industry. It is probable that the equivalent of £500,000 a year is spent on research, which yields, however, a return of about £35,000,000. The cost of research is met by the industry, and this cost is looked upon as an insurance for the con-

After being hauled by truck or barge to the cannery, the fruit is first fed into remarkable machines known as Ginacas, which remove the shells and cores and leave the fruit in cylindrical form to fit within the cans

Strips of mulch paper, similar to roofing paper, are placed on the ploughed earth. These machines lay the paper and fumigate the soil all at the same time



The distribution of pineapple-growing areas and canneries is shown above

Spraying work in progress on a pineapple plantation in Hawaii

Mechanised harvesters are being used to replace the shoulder slings in which pickers formerly placed the fruit

tinued existence of the industry. The National Canners' Association of America is primarily a research organisation to improve canning methods and the products of the canning industry and to engage in fundamental research into the nature of canned foods. The American Can Company not only sells all the cans required by the pineapple industry, but also enters into technical problems concerning pineapple canning. The scientific work on the agricultural side is carried out by the Hawaiian Pineapple Research Institute, financed and supported by the Hawaiian Pineapple Canners' Association. The Institute has been responsible for the classic research on the control of the mealy bug, on the discovery of new soil fumigants to destroy obnoxious soil organisms, on the use of diesel oil as a base for chemical mixtures used to suppress noxious weeds, and for the correction of the cumulative deficiencies of major, minor and trace elements and of organic matter in the soil which has been repeatedly planted and replanted with the same crop over a long period of years. In the search for the perfect pineapple 18,000 new hybrid varieties have been obtained by cross-breeding. The Institute is also engaged in research on the use of new growth-regulating hormones. It maintains close touch with the plantations, but, in addition, the pineapple companies individually maintain their own organisations to elucidate practical planting and processing problems.

Quality standards

Throughout Mr. Cooke's report one is constantly reminded of the care taken to maintain standards, both in the field and the factory. Photo standards are provided to describe the shape of the fruit and fruit models define the standard of picking, colour and brilliance of flesh of the fruit, and define the limits of the grades of cut fruit to prevent variation in the standards of picking due to seasonal and other fluctuations in the quality of the fruit received. Quality control extends to every stage of production.

Organisation of the industry

The author outlines the organisation, staff, labour relations and the commercial side of the industry. He shows how from humble beginnings about 60 years ago the organisation has developed into the present 12 company-operated plantations and nine canneries owned by eight companies. Only two of these companies have their roots in America, the remaining six being island owned and island controlled, forming a close-knit group related by blood, business and long association in the islands.

These eight companies are no longer self-contained or self-sufficient, but are firmly united for the promotion of their mutual interests. Today the Growers' Association of Hawaii is a simple trading association, with head offices in San Francisco to arrange collective advertising and to perform intelligence services for the industry. It forms the link between the industry and the Government, defends the industry in legal and other difficulties and has a useful arrangement for the exchange of patents on a royalty basis between its members. In other respects, the companies operate on a competitive footing. Mr. Cooke also outlines the important part that advertising has played in the development of the industry and the complementary relationship that exists between the pineapple and the tourist industries.

Further expansion

The limiting factors to the further expansion of the industry are the supply of fruit and the present high cost of production. To ensure the continued stability of their business the leading companies of Hawaii have been compelled to extend their activities to other countries in order to obtain sufficient fruit to meet increasing demand and to place themselves on a sound footing to meet competition should a slump in prices occur. The author makes no comparison regarding the relative merits of Hawaii and Malaya for the cultivation of the pineapple, but one is left with the impression that, despite the efficiency of the organisation and the success of the industry, the pineapple in Hawaii is not growing under the most suitable climatic and soil conditions, and that some of the methods introduced in connection with the cultivation of this fruit in Hawaii are rendered necessary by adverse conditions. If this be so, it may well be one of the contributory reasons why the Hawaiian interests are looking to other countries for their future development.

D. H. GRIST.

EAAFRO's First Annual Report

THE recent appearance of the first Annual Report of the East African Agriculture and Forestry Research Organisation, which—following present-day tendencies to abbreviated designations—has become known as EAAFRO, marks an important step forward in the history of agricultural research in Africa, and in fact in the British Colonial Empire as a whole.

The report, it is true, only deals with the course of events up to the end of 1948, and on this account is to an extent out of date, more especially since a number of important developments have occurred since it was written. Nevertheless it is noteworthy since it provides a record of the first fruits of an enterprise which is the outcome of a great deal of unobtrusive effort both in this country and also overseas during the past half dozen years, and which is in all probability pregnant with much more extensive developments in the future.

The history of agricultural research in East Africa has been somewhat chequered. The forerunner of the present organisation was the East African Agricultural Research Institute, at Amani in Tanganyika. This was originally inaugurated in 1902 by the Germans when Tanganyika was still a German colony. At the conclusion of World War I the territory passed under British mandate, and for a period Amani languished on a care and maintenance basis. Largely as a result of the Imperial Agricultural Research Conference of 1927, it was reconstituted as a research institution to serve the needs of East Africa as a whole under the direction of Mr. W. Nowell, C.M.G., C.B.E., assisted by a staff of highly qualified scientists. It accomplished much valuable scientific work, but was handicapped by insufficient financial resources and by its situation in the Usambara Mountains, remote from the main centres of production and unprovided with level land suited for field experiments.

During World War II its scientific staff became largely dispersed to other duties. The conclusion of the war afforded an opportunity for reorganisation, and as a result of two conferences held in Nairobi in 1946 and 1947 EAAFRO came into being.

It embraces within its scope all forms of agricultural and forestry research in East Africa and is closely linked to the parallel organisation for veterinary research which is known as EAVRO, established simultaneously. It is anticipated that it will be eventually assimilated in greater or lesser degree to the various crop research institutes at present functioning in East Africa, while it is designed to provide a flexible organisation which can undertake new research as and when the need arises; Amani has already been incorporated in it, while close touch is being maintained with the Empire Cotton Growing Corporation's research station in Uganda and with the Overseas Food Corporation's work in Tanganyika.

To assist in this policy an East African Agricultural Research Council has been set up with a number of research sub-committees, the membership of which included representatives of the territorial Departments of Agriculture, Research Institutes and official and unofficial administrative and sectional interests.

Dr. B. A. Keen, F.R.S., formerly Assistant Director of Rothamsted, was appointed the first Director with Dr. H. H. Storey, F.R.S., formerly Secretary of the Colonial Agricultural Research Council as Assistant Director.

The recurrent expenditure of the new Organisation is being shared by the United Kingdom Government and the territorial governments concerned, while the United Kingdom Government is providing, from Colonial Development and Welfare funds, the whole capital cost of the new headquarters, an excellent site for which has been obtained in the Muguga Forest Reserve, 12 miles from Nairobi.

General agreement has been reached on the functions of the new organisation, based on the recognition that three stages of work connect research with practice; firstly basic or fundamental research; secondly, technological investigation in which the knowledge gained in stage one is studied within the environmental variations of East Africa; and thirdly the practical application of the results of stage two.

It is recognised that EAAFRO is concerned with the first two stages, while the technical departments of the individual territories are concerned with the second and third stages. It is, therefore, at the second stage, with which both are concerned, that close co-operation between EAAFRO and the territorial technical departments must be built up.

Scientific work of the organisation

In describing the scientific work undertaken in 1948, the Director emphasises that conclusions reached from soil research in temperate climates cannot necessarily be applied in tropical conditions. High priority is therefore being given to soil investigations. A fertiliser team is now working and has laid out and harvested a large number of field experiments. Under a second scheme, operated by the Kenya Department of Agriculture in collaboration with Imperial Chemical Industries, fertiliser experiments have been carried out on European farms in the Kenya Highlands. These two schemes are closely co-ordinated and both come under the general scientifi control of the Director of EAAFRO.

In the laboratory, samples of soil and produce from the plot sites are being systematically examined, the basic research project being the study of the inherent fertility status of tropical soils.

Investigations into the problems of plant diseases also form an important part of the programmes and work is now in progress on virus diseases of cassava and of groundnuts, while a team, financed by a grant under the Colonial Development and Welfare Acts, is investigating the Sudden Death disease of clove trees on the islands of Zanzibar and Pemba.

As the report points out the establishment of EAAFRO is a pioneer venture and from the experience gained regional research organisations to be set up in the future in other parts of the Colonial Dependencies should be able to draw useful conclusions.

The report is obtainable from the Secretary, East African Agriculture and Forestry Research Organisation, P.O. Box 601, Nairobi.

The Importance of Humus in Assam Tea Estates

(*Continued from page* 282)

amply supplied with humus. Prunings return 3 to 10 tons of fine vegetation annually, whilst 10 to 30 tons of leguminous foliage are in addition supplied per acre by shade trees in well shaded areas. Practically no deep cultivation is carried out, consequently there is no loss of nitrogen to compare with that released by ploughing and tilling in preparation for an annual crop. In fact, the conditions under healthy, well-shaded tea are comparable with those found in the jungle.

Any cattle manure and line sweepings available can be used in tea nurseries and in young tea with beneficial effect, but composting on a large scale involves spoliation of the land from which the organic matter is taken, and it is more logical to apply fertilisers to increase crops so that the organic wastes therefrom shall be converted to humus by nature's process in the soil on which they are grown.

The Scottish Raspberry Industry

C. H. CADMAN, Ph.D.

Scottish Raspberry Investigation (East Malling Research Station), University College, Dundee

Fruit growers in many parts of the world will find much to interest them in the following account of the Scottish raspberry industry, especially as an example of the manner in which, even in countries with an age-old tradition of agriculture, new crops may rapidly expand under the influence of changing conditions and new ideas. The industry has encountered a number of vicissitudes prominent among which has been the spread of virus diseases, while the marketing and disposal of the crop are also giving some cause for concern. The history of the industry, its problems and the future outlook are discussed below.

SUCH facts as we possess concerning the early history of the raspberry as a cultivated fruit make an unsensational story. It figures in the lists of garden fruits left by writers from Elizabethan times onwards, but appears always to have been held in low esteem. Parkinson, in his *Paradisus* of 1629, allows, almost grudgingly, that the berries ' please the taste of the sicke as well as the sound ' and that ' the Conserve or Syrupe made of the berries is effectuall to coole an hot stomacke, helping to refresh and quicken up those that are overcome with faintnesse.' Varieties cultivated in Europe up to the present day have been derived almost entirely from the wild raspberry of North Europe, *Rubus idaeus* of Linnaeus, which is said, by legend and Pliny, to have provided fruit for the gods on Mount Ida.

Despite such excellent recommendation, the raspberry has waited long for recognition as a fruit worthy of commercial exploitation. Large-scale cultivation is a development of the last half century, and appears to have taken place concurrently in several parts of the world, most notably in Britain, the Netherlands, North America, Tasmania and New Zealand.

Development of the industry

In Scotland raspberries are known to have been grown on a commercial scale near Blairgowrie, in East Perthshire, in the 1880's, at a time when the local strawberry growing industry was declining in the face of competition from other districts. The success of the new venture was stimulated both by rises in fruit prices, subsequent to the depression of the 1890's, and by the extension, at the turn of the century, of the small holdings movement.

Typical fruit of Malling Landmark raspberry

Raspberries, in some respects, lend themselves well to culture on a small scale; yields in the early days were high, and the fruit found a ready market. As a contemporary writer put it ' bakers, grocers, clothiers, masons, joiners, manufacturers, lawyers, clergymen ' all took part in this ' back to the land ' movement in pursuit of the profits from raspberry growing, which laid the foundations of the modern industry. Subsequent developments occurred rapidly, for by 1907 raspberry growing had become an established industry around the small towns eastwards of Blairgowrie and had spread to Auchterarder, in West Perthshire. By 1912, the first year for which returns are available, the acreage of raspberries in Scotland was 2,300; of these, 197 acres were in Angus and 1,670 in Perthshire, the bulk of the latter being in the Blairgowrie district.

The present position

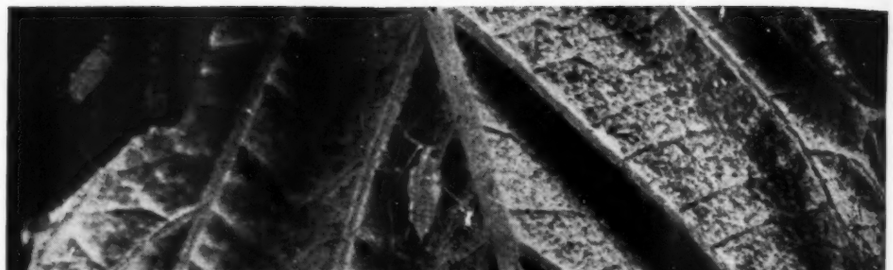
Having weathered the difficulties of two world wars and the disastrous depression of 1930 and 1931, the industry has, since 1947, enjoyed a return to prosperity. Now, in 1949, the total raspberry acreage in Scotland is 6,190, of which 3,046 acres are grown in Perthshire, 2,455 in Angus, and smaller acreages, 267 and 149 respectively, in Fife and Lanark. As these figures show, the greater part of the Scottish crop is grown in the eastern half of the country, a smaller proportion being sited in the Clyde Valley district of Lanarkshire. The two areas differ in important respects. The Clydeside industry is associated with market gardening, glasshouse crops and tree fruits, and caters mainly for the fresh fruit market. Raspberries in the eastern area are grown principally as a field crop on mixed farms and small holdings, the output going mainly to the preserve trade.

Structure of the industry

The influence of these markets is reflected in the structure of the industries in the two areas. In 1931, very nearly half the total acreage in Angus and Perthshire was

grown on holdings of 50 acres or less. Since then, however, the entry into the industry of jam manufacturers, who either grow and process their raspberries in Scotland or supply fruit to their own factories in England, has weakened the position of the small man, who nowadays faces powerful competitors. Large individually-owned acreages account for the major proportion of the present total. In the Clydeside area, on the other hand, the individual holdings of raspberries have remained small.

Though the growing of raspberries in Angus and Perthshire has now become a traditional and highly-localised industry, there are doubtless other areas in Scotland equally or even better suited to the crop. Indeed, efforts are at present being made to develop raspberry growing in the Moray Firth districts centring on Inverness. Ready access to casual labour for the harvesting of the berry crop is, however, an over-ruling consideration, and is the principal reason why the industry has become concentrated around the towns and villages of the fruit-growing areas. Access to railheads has become less important since the development of road transport.



Aphids, *Amphorophora rubi*, one of the principal virus vectors, feeding on a raspberry leaf

Climatic and soil requirements

The rapid expansion of raspberry growing probably owes something to the fact that the crop is not a particularly exacting one to grow. It appears to do well under northern climatic conditions of cool summers and moderate annual rainfall (26 to 30 in.), essential requirements being well drained, fertile, slightly acid soils and protection from spring frosts and severe winds. Most of these are provided by the gently undulating slopes of Strathmore with their easily worked 'sharp' or gravelly soils. The whole of this broad valley, which stretches for some 50 miles through East Perthshire and Angus, is subject to the late spring frosts that are of regular occurrence in Scotland in late April and early May. Frost is the greatest hazard to be faced by the raspberry grower, and careful selection of planting sites is of major importance. In recent years a considerable acreage has been planted in the coastal, frost-free districts around Montrose.

Cultural requirements

The culture of raspberries does not involve many specially skilled operations. The routine is determined partly by the perennial nature of the crop—a plantation having an average life of eight to nine years—and partly by the fact that raspberry canes are biennial growths, produced one year, to flower, fruit and die in the year following. The initial cost of establishing a plantation is high; at the time of writing, between £90 and £120 per acre. Most of this expenditure is incurred by the canes for planting (at least £30 to £60 per acre at present prices), manures, posts and wires required for building fence work to support the fruiting canes, and cultivation up to the time the plantation produces its first full crop, usually in the third season after planting. Since the raspberry crop makes heavy demands on potash, nitrogen and organic matter, manuring is a costly business and is one of the first things to be neglected when prices fall. Most of the routine operations are carried out by regular labour, one man being required for each ten acres of plantation. Jobs such as pruning and lacing-in of canes to the training wires are often done by casual labour, paid at piece rates. The following figures for some of these items illustrate clearly enough the rising costs of production over the years:

	Cost of canes per 1,000	*Casual labour per week*	*Contract horse work per hour*	*Lacing canes per 100 yds.*
1913 ..	20/-	16/8	1/-	2d.
1930 ..	30/-	29/2	2/3	7d. to 9d.
1949 ..	160/- to 300/-	106/-	4/-	1/6

Seasonal cultivations are still largely done by horse work though the availability of tractors able to negotiate the narrow (5½ to 6 ft.) alleyways and headlands is leading to increased mechanisation.

Harvesting

During the picking season, which usually lasts from mid-July until the third week in August, there is a great influx of townspeople and holidaymakers to the fruit-growing districts, and in post-war years growers have had no difficulty in recruiting labour. Fruit for jam is picked into pails and the pickers paid on the weight gathered. Most growers nowadays pulp the fruit on their own holdings, using a sulphurous acid preparation, and store the fruit in kegs until the jam manufacturers take delivery.

Fruit for canning or quick freezing has to be selected specially for quality and degree of ripeness and is therefore more costly to produce. The pickers are paid higher rates and the plantations have to be picked over more frequently for dessert fruit than for jam fruit production. The fruit is picked into baskets and transported in these to the factory as soon as possible.

The choice of variety of raspberry grown also enters into this picture. Whilst high yield is the first consideration of the jam fruit producer, dessert fruit production often necessitates the growing of high quality varieties, not all of which are prolific croppers.

As a rule, picking rates increase after the first flush of the crop is pulled, though here again there is a contrast between the handsome basic rate of ½d. per lb. in 1913 and the 1½d. of 1949. A good picker in a full crop can make as much as 20s. a day.

To turn to the credit side, raspberry growing is, of course, no more certain a proposition than any other branch of fruit growing. It is always the high returns of the good years that tempt the grower to continue.

Yields

From plantations in full bearing, *i.e.* in the third and subsequent years after planting, most growers are well satisfied with an average yield of 2 tons per acre. Yields can often enough reach 4 tons, more rarely 6, whilst in poor years the majority of plantations may give less than the 2-ton average.

Marketing conditions

During the war years, almost the entire output from the east of Scotland was bought by the Ministry of Food at negotiated prices which, in 1946, the last

year of controlled prices, rose to £112 per ton. With the lifting of restrictions on private sales, prices immediately soared to unprecedented levels. Since 1947 an appreciable proportion of the crop has been sold on a limited term contract basis to jam manufacturers, an arrangement that has done much to introduce an element of stability into the situation.

The ruinous level to which prices fell in 1930 and 1931, when raspberries realised £13 to £15 per ton, is still a vivid memory and the downward trend of prices at the present day is being watched with anxiety. There has not as yet been a reversion to the conditions of cut-throat competition between growers for the sale of fruit to brokers and merchants, such as prevailed before the recent war, and often led to disastrous slumps in prices.

Damage by frost, pests and disease

Economic forces are not the only cause of poor returns. Losses due to frost damage and the incidence of pests and diseases can be, and have been, just as crippling to the industry.

Raspberries growing with orchard fruit in Clydeside and trained in characteristic local manner

Promising work by Mr. D. Booth at the West of Scotland Agricultural College, on methods of prevention of frost damage, has now, unfortunately, been terminated, though it appears doubtful whether any remedy other than careful choice of planting sites is available to growers.

Virus diseases

Virus diseases are a more insidious cause of falling yields and have been the focus of work carried out by a research unit set up, at the industry's request, by the Agricultural Research Council in 1943, and stationed at University College, Dundee, under the direction of the East Malling Research Station. The spectacular and general collapse of the variety Lloyd George in the early years of the last war is only one of a series of similar crises which have chequered the history of Scottish raspberry growing, and experimental evidence leaves no room for doubt of the serious extent to which these have been caused by the spread and accumulation of virus diseases. It has been found, at Dundee, that two species of aphids, which commonly live on raspberries, are the principal vectors of raspberry viruses, none of which have, so far, proved to be sap transmissible. But the rapid deterioration of stocks, through virus infection, has been brought about more efficiently by the traditional method of digging cane for planting from fruiting plantations where, for practical reasons, little or no effort can be made to check the natural spread of virus diseases. Research findings have therefore been applied to the production and propagation, under conditions of isolation from infection, of foundation or 'nuclear' virus-free stocks, and to the encouragement, through certification schemes operated by the Scottish Department of Agriculture, of the bulk propagation of such nuclear stocks as a commercial venture distinct from fruit growing. The general aim of these schemes is to provide the industry with a continuous supply of pedigree healthy stocks of current commercial varieties, and so to avoid the recurrence of crises precipitated by wholesale degeneration of stocks.

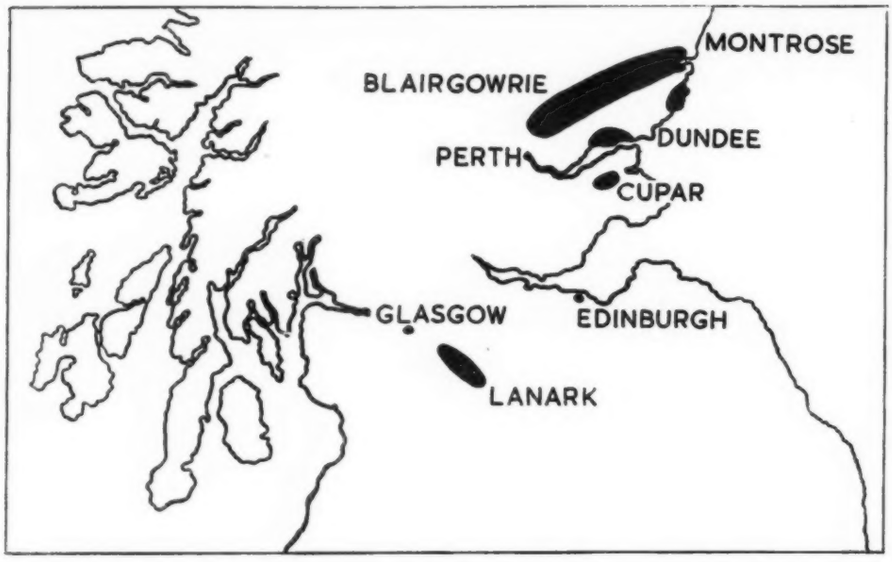
The cane-nursery system

Propagation of planting cane, on what is known as the cane-nursery system, has in recent years become a profitable sideline to general farming in districts isolated from the congested fruit growing areas. Whilst many fruit growers have been quick to take advantage of these new sources of supply of healthy stocks, the higher prices they command still tend to encourage the use, for new plantings, of surplus cane from fruiting plantations that has to be dug out as a necessary routine practice. The scope of a subsidiary propagation industry will in the future be strictly limited by the demand for planting cane; there is no doubt that a state of over-production can all too easily be attained.

Virus resistant varieties

It is through the gradual deterioration and ultimate extinction of old and well-tried varieties that the industry has felt the effects of the inroads of virus disease, and growers have been dependent on the timely appearance of new varieties to replace those put out of currency by virus infection. Although the great majority of successful commercial varieties of the past have originated as chance seedlings, the breeding work of Mr. N. H. Grubb, at the East Malling Research Station, culminating in the recent production of a series of new and valuable varieties, has been recognised as a major contribution to the improvement of the raspberry industry in Britain. Scientifically planned breeding, coupled with systematised propagation based on research in the virus diseases, offers hope at least of prolonging the useful life of new varieties and ultimately there is a prospect of current research findings leading to the production of varieties resistant to virus infection. For the present there

Cane nursery propagation of raspberry planting stock; appearance in second year



The distribution of the major Scottish raspberry-growing areas

seems no short cut to the control of virus disease in the field. It is imperative to plant the healthiest stock obtainable and current research has shown that pedigree planting cane of the majority of current varieties can be produced and maintained only by a system of glasshouse testing and bulk propagation under stringent conditions of isolation from sources of infection. Additional sources of healthy, nuclear stocks may become available in New Zealand where, in the absence of the aphid vectors, propagation of virus-free stocks is a simple and straightforward matter.

With the rapid expansion of the Scottish raspberry acreage from the 4,000 acres of the war years to the present level of 6,000 acres, and the recent introduction of new varieties and better stocks, there is a noticeable improvement in the general health and level of cropping of plantations. But replacement of old and degenerate stocks is necessary on such a large scale as to make an overall improvement of standards a long-term achievement.

Insect pests and fungus diseases

For all three of the major insect pests of raspberries—the raspberry moth (*Incurvaria rubiella*), the clay-coloured weevil (*Otiorrhyncus singularis*), and the raspberry beetle (*Byturus tomentosus*)—efficient control measures are now available, and their attacks should become a negligible source of loss of crop. The first two of these damage or destroy the developing fruiting laterals in early spring and summer. The grubs of the raspberry beetle, which develop from eggs laid in the flowers, disfigure the developing fruit and, since they remain in the ripe berries, are a very undesirable contaminant of canned fruit.

Fungus diseases, of which Cane Spot (*Elsinoe veneta*) is the most widespread and economically important, fluctuate in severity of attack from one season to another. Varieties differ considerably in degree of susceptibility to Cane Spot, and the production of resistant types in future plant breeding work should not be difficult to achieve. On susceptible varieties, the disease has proved to be controllable by means of routine application of lime sulphur.

Although raspberry growers are becoming more conscious of the value of routine spraying and dusting schedules, their more widespread adoption is essentially a matter of economics. Developments have been hindered also by the general lack of suitable equipment and the high cost of specialised machinery which can only be used for limited periods each season. Delegation of such work to contracting firms is not wholly satisfactory, on account of the large acreage to be serviced over short and narrowly defined periods of the year.

Over-production dangers

It is something of a paradox to find that whilst the results of research and advisory work and of certification schemes are all tending towards an improvement in the level of cropping, the spectre of the industry is over-production. Over-production and competition with imported soft fruit pulp and gluts of home-produced stone fruit are the principal factors that have led to depression in the Scottish industry in past years. The position is more difficult to assess at the present time.

Two unsuccessful attempts to stabilise the situation by the establishment of a raspberry marketing scheme have already been made, and it still remains questionable whether a marketing scheme uncoupled with an acreage limitation and quota system can achieve the stability of prospects which most growers would like to see. A guaranteed price inevitably encourages the planting of larger acreages and, under the present system of distribution, there would seem to be definite limits to the tonnage which the various trades are able to absorb. The resumption of canning and the growth of the new quick-freeze process are being looked to as expanding markets, of which home-grown fruit may well expect to have the monopoly, but both demand a high quality product. In 1949, the estimated total output from the east of Scotland was 6,500 tons, as compared with the 10,000 tons of the 1937 peak year. The bulk of the 1949 crop was consumed by the jam trade and probably not more than 4% to 5% was accountable to the canning, quick-freezing and fresh fruit trades. Though there is doubtless a large and unsatisfied demand for dessert quality fruit in baskets for domestic consumption, profits are slight unless the systems of distribution and retailing are efficient.

If the tonnage of imported pulp again increases, it seems safe to say that competition is most to be feared from berry growing areas overseas where costs of production are lower.

The future

In the writer's opinion, the main hope for the future lies in the application of research to the problems of producing the maximum crop from the minimum acreage and of reducing the costs of production. So long as the demand and prices for jam fruit remain high, heavy cropping will be the grower's first desideratum and no doubt the upgrading of the health of stocks and varieties in circulation will effect a permanent improvement in yield. If market demands become more selective, there will be a greater need for either special or multiple purpose varieties of high quality. The improvement of the raspberry through cross-breeding with other *Rubus* species is still largely an unexplored field in this country, and this approach may well offer unforeseen possibilities of combining the desirable features of disease and frost resistance with quality and high yielding capacity.

Colorado Beetle

All commercial potato crops in certain areas of eastern and south-eastern England are being treated with insecticidal sprays or dust this summer as a precaution against the Colorado Beetle. The campaign has been arranged by the Ministry of Agriculture and Fisheries.

Hill Country Grasslands

Part II

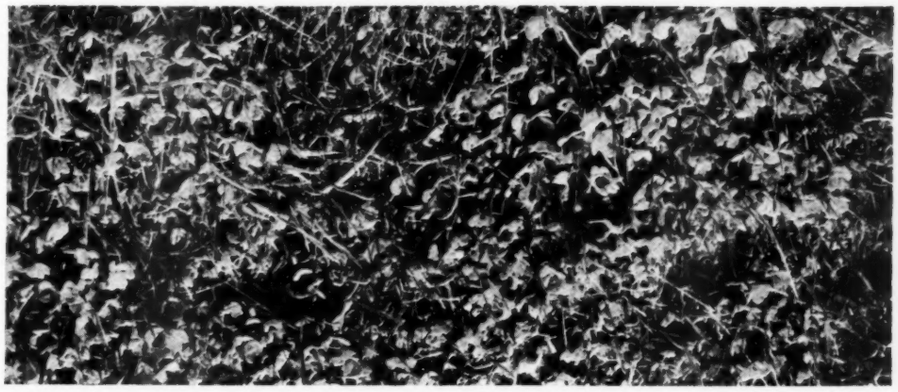
E. BRUCE LEVY

This is the concluding portion of Mr. Bruce Levy's article, the first part of which appeared in our issue for June.

IN New Zealand it has been found that with a build-up of soil fertility by top dressing with phosphates, the introduction of suitable clovers and appropriate grasses and rotational grazing, deforested, deferned and descrubbed hill country can be made to carry three to four ewes per acre with some cattle, and we regard this as the minimum desideratum. Unless this can be carried, insufficient stock urine and dung are returned to the land to encourage the growth of the more productive grasses and clovers, particularly perennial rye grass, crested dogs-tail and white clover. Top dressing with phosphate alone can also accomplish this, provided clovers are present, but I am sceptical whether this would be the case with hill country in Britain. It seems imperative that the surface peat layer should be removed before much improvement can take place. This layer has been built up over the centuries with the accompanying leaching of the bases in the soil and the subsequent development of acidity, thereby creating an environment unfavourable to various beneficial biological activities in the soil which are responsible for the breakdown of organic matter and the maintenance of soil structure.

The only effective remedy is lime and still more lime, until the acidity has been sufficiently reduced. I have no idea how much lime would be necessary but imagine it would be well beyond the scope of private enterprise to provide it and, therefore, it must be a matter for state assistance or state enterprise, as would be the drainage of swamp areas and similar large-scale reclamation works.

In New Zealand also there are millions of acres that are beyond the resources of the individual settler to reclaim and, as the demand for food grows and the available land diminishes relative to the demand, it must inevitably become a duty of the state to finance the reclamation and development of such land. Under New Zealand conditions, I am convinced that state aid for financing such development would pay handsome dividends, but I am more doubtful about the more elevated hill country in Britain; I feel, however, that there are millions of acres of the lower hill country that would repay national aid for its development.



The introduction of these clovers, accompanied by top dressing, into the hill country turf of New Zealand will build up nitrogen and encourage the growth of better grasses

Heather and bracken fern (secondary growth) on the uplands of Britain, preliminary to the return of forest cover

These sheep provide store animals for the lowlands to fatten; they take with them potash, phosphate and lime, thus depleting the fertility of the hills

In steep and rocky country, afforestation cum grassland appeals as a reasonable procedure in the better development and utilisation of the hills

Sir George Stapledon's work at Cahn Hill is a notable demonstration in this regard, although in the writer's view too great stress may have been laid on the costs of development in the early years, having regard to the long period over which the reclaimed hills would certainly carry additional stock and give their added quota of food. It is true that the initial costs are high, but they should be regarded as expenditure to create a national asset out of land that, prior to development, had little or no value. In other words, development should not be regarded as a direct charge on the land but as expenditure to expand national resources, the nation paying for and writing off development costs and leasing or selling the resulting assets at their new productive value. The reclamation of the Zuider Zee in the Netherlands may be cited as a parallel case in point.

Need for critical surveys

The main danger is that once the asset has been created deterioration to its original condition does not take place by faulty farming methods. In any event developments should not be undertaken where natural conditions are unduly unfavourable. In grassland farming there is little man can do in the face of extremely unfavourable climatic conditions, and it is sounder policy in such cases to take from the country what little it can yield at practically no cost, rather than to expend vast sums in attempts to raise production.

In the Montane tussock country of the South Island of New Zealand the climatic conditions are too severe to warrant expectation of much improvement even with the expenditure of vast sums of money. On the lower and easier tussock country, however, large areas have been developed out of tussock and today it is very profitable and self-supporting country under rotational farming.

It is only, therefore, by critical survey and analysis that the potentialities of any hill country can be decided, and this must be a prelude to development. There are, however, probably millions of acres in Britain and in New Zealand that would pay for development on a national basis by state enterprise or by state-aided private enterprise.

Response to ploughing

A striking feature in Britain is the good response to ploughing, reseeding and fertilising of hill country that can be ploughed. The turned furrow buries the top peaty layer and a seed bed can be made. Such species as S23 rye grass, cocksfoot, Yorkshire fog, brown top and white clover can be established on ploughed and sown hill country, even without a great deal of fertiliser after the initial dressing at time of sowing, and the possibilities of converting large areas of hill country into quite useful grassland are impressive. Some of the takes I have seen compare more than favourably with the initial swards on marginal land in New Zealand. The secret for these marginal lands is not to skimp the initial development. Heavy lime and fertilisers at time of sowing down and liberal applications of additional fertilisers in the first year of the pasture are necessary. Three to four tons of carbonate of lime to correct the initial high soil acidity, with nitrogen, phosphate, and potash; basic slag up to as high as 6 cwt. per acre in the first year may be necessary. In succeeding years regular dressings of 3 to 4 cwt. of N.P.K. or basic slag should be applied.

Afforestation

Some of the more elevated hill country, however, looks hopeless for grazing and here the extension of afforestation wherever it is possible to get a tree to grow seems the best course. Large continuous tracts of country in forest seem not to be indicated, but where possible a combination of forest on the highest, more difficult situations, with grassland farming on the lower slopes and with more fertile valleys, appears to be the appropriate aim.

This forest-cum-grassland concept has much to commend it even although some of the grassland areas are used as farm holdings for foresters who must necessarily live close to their work. Particularly striking is the way many newly planted forests are developing on difficult hill country in Britain, and one can envisage the ultimate developments of a landscape of tree-clad hill-tops, interspersed with grazed grassland and studded with picturesque stone cottages.

Withdrawal of soil fertility

The possible deterioration of the hills owing to soil fertility losses as a result of store-stock farming needs mention. Unimproved hills cannot fatten stock, but they are an invaluable asset to the lowlands since they can provide store animals for the lowlands to fatten and full-grown

(*Concluded on page* 298)

An example of erosion in New Zealand. Britain is not so susceptible owing to the surface peat layer and dense matted turf often well developed on the hills

Rice Enrichment

Recent Developments in its Nutritional Improvement

P. RINGNES and C. K. PARMAN

With the increased consumption of highly milled white rice in the Far East, beri-beri has become increasingly prevalent. This was found to be caused by the removal of certain vitamins in the husk. Our contributors have had considerable experience in overcoming this problem, and in the following article they describe the Roche rice enrichment process and the results that it has given so far.

AFTER wheat, rice is the most important cereal in the world and for hundreds of millions in the Far East it is their staple food. Modern milling techniques made it possible to produce a much whiter and more palatable rice than formerly, with improved keeping qualities, but with increased consumption of white highly milled rice, the disease known in the East as beri-beri became increasingly prevalent among rice-eating populations and numerous investigations indicated that it was caused by deficient intake of vitamins.

It was shown that in the milling of rice minute quantities of vitamins are removed and in 1926 Jansen and Donath isolated from rice bran the vitamin B_1 or thiamin; subsequent research showed that at least two other vitamins—namely B_2 or riboflavin and niacin are also removed in appreciable quantities in milling. Beri-beri itself is caused by a diet deficient in thiamin and symptoms of riboflavin deficiency also occur endemically where milled rice is the staple diet. Nevertheless, in spite of its nutritional limitations highly milled rice is greatly preferred to undermilled or husked rice.

The improvement of rice diets

The need for improving rice diets has occupied the attention of nutritionists for a number of years. Two main lines are open, (i) improvement of diet by introducing other foods, and (ii) improvement of the rice itself. Under the former heading efforts have been made to increase consumption of milk, wheat, meat and vegetables, but progress in this direction has been slow. The existing shortage of rice in the Far East has, however, helped to induce some variation of diet by the inclusion of other foodstuffs. Under the latter heading the improvement of the nutritional quality of rice can be based either: (*a*) on the preservation of the natural vitamins in rice, or (*b*) the enrichment of milled rice with synthetic vitamins.

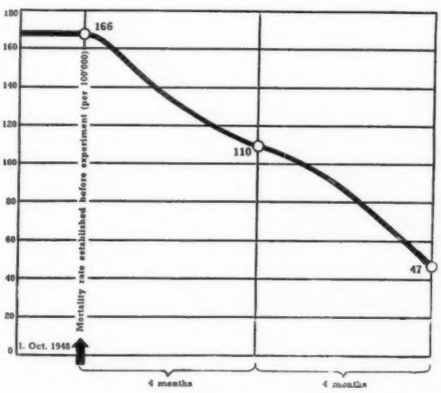
(*a*) The preservation of the natural vitamins

The two methods available are either some form of parboiling or undermilling. Parboiling involves steeping padi in water, after which it is subsequently steamed, dried and milled. By this process the vitamins are transferred to a greater or lesser extent to the endosperm and thus survive milling.

Two new modified methods of parboiling have become evolved of recent years, namely the Huzenlaub process and the Malek process. Although parboiled rice is nutritionally superior to highly milled rice and has excellent keeping qualities, its characteristic taste, due to substances in the husks, is not appreciated by Eastern populations, except perhaps in India. The high initial costs of parboiling plants is also a deterrent factor. It may be that the objectionable taste could be removed by breeding new varieties.

Undermilling consists, as the name implies, of conducting the milling of rice in such a manner that the bran layer and the germ are largely retained on the kernel. This can be done on existing mills, but considerable work is in progress on new types of mills designed to preserve a larger quantity of the bran and germ. Undermilling also gives higher yields of rice, a factor of importance during years of rice shortage. It is, however, difficult to store undermilled rice, as the retained bran and germ layer contain an appreciable amount of oil which tends to go rancid during storage and attracts destructive insects. The difficulty could perhaps be got over by shortening the period between milling and distribution and by storing rice in the form of padi. In practice, however, this is often difficult because of the complexities of distribution and lack of storage accommodation. It might be possible to remove the oil by extraction with a solvent, but this would increase the cost and might be economically unsound. Until the problem of rancidity has been solved undermilling will hardly offer a practical solution; moreover, undermilled rice is unpalatable and this, too, is an obstacle to its adoption.

No doubt from a nutritional standpoint parboiled or undermilled rice would give an improved diet, but, for the reasons given, white rice must long continue to be preferred.



Bataan nutrition experiment (95,000 persons). The curve shows the drop in beri-beri following the introduction of vitamin-enriched rice

(*b*) The enrichment of rice with synthetic vitamins

This principle was first adopted when the United States War Food Administration decided to introduce compulsory enrichment of white flour as a war measure. From a nutritional point of view, white flour and milled rice are similar, since both are foodstuffs which lose essential nutritive factors in the milling process. Whereas, however, the restoration of the normal vitamin level of white flour is simple, vitaminisation of milled rice is a more difficult problem since, before cooking, rice is washed and the washing water is discarded; in consequence the added vitamins, which are water-soluble, are washed out and it accordingly becomes

necessary to protect the vitaminised grains with a digestible water-repellent coating. Moreover, the enriched rice must be palatable, of good colour and of satisfactory digestibility, while the process must be simple and cheap.

The Roche process of rice enrichment

The possibility of developing a method for enrichment of milled rice on these lines was first investigated by the firm of Hoffmann-La Roche and Co. prior to the last war and, as a result, the Roche rice enrichment process was developed.

Essentially it consists of two stages, (1) the production of a vitamin fortified rice which has been termed Premix, and (2) diluting the concentrated Premix with ordinary milled rice to give an enriched mixture.

The Premix is prepared by spraying on to milled rice the desired vitamins (thiamin, riboflavin and niacin) in a suitable solution. After evaporation of the solvent the rice grains are coated with a combination of edible film-forming substances which are insoluble in cold water, but melt on heating, whereby the enclosed vitamins are able to distribute evenly throughout the rice.

The treated grains (the Premix) containing a high quantity of vitamins are mixed with ordinary milled rice in the correct proportion to yield the enriched rice containing the desired vitamin levels. The dilution ratio is normally 1 : 200, but may be varied to meet specific requirements in a given area.

The plant for processing the Premix is illustrated in the accompanying diagram.

White rice *R* is introduced into the motor-driven trumbol *A* (a rotary device used in the rice mill for coating or mixing rice after polishing) through a hopper. The trumbol is rotated at a fixed rate while the vitamin solution from the kettle *B* is allowed to flow into the trumbol via the distributor pipe *E* which slowly sprays the solution over the rotating rice grains through the perforated section *F*. After the final portion of the vitamin solution is blown out of the sprinkler pipe with compressed air from *G*, the blower is started to draw preheated air through the rotating trumbol until the rice is thoroughly dry. Half of the coating solution in kettle *C* is sprayed over the rotating rice through *F*. After thorough mixing has been achieved and the major part of the solvent, evaporated talc is added (a suitable iron salt, iron pyrophosphate, may be mixed with the talc and added at this stage). When the talc coating has been thoroughly distributed, a second coating of the protective solution is applied and dried as before. The finished Premix is removed from the trumbol through discharge slots and screened to remove 'agglomerates' which form to the extent of about 1% of the rice during processing. Enriched rice is prepared by mixing Premix and white rice in the ratio of 1 : 200 in any suitable mixer.

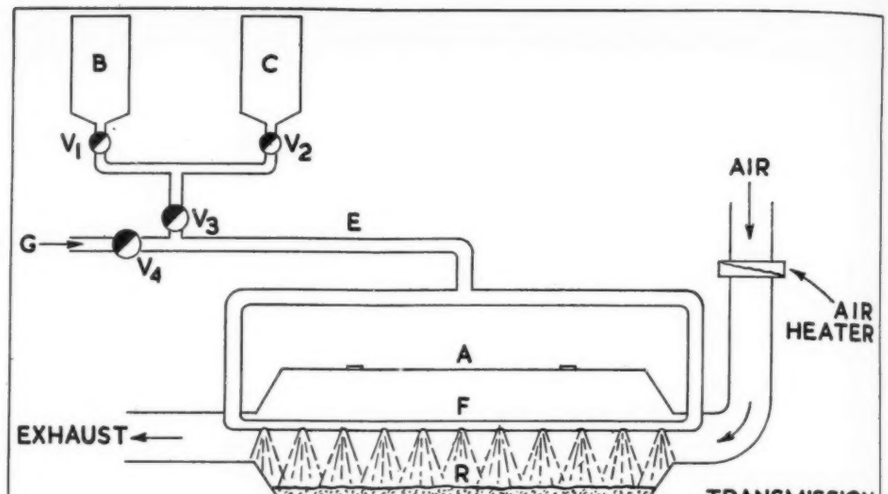


Diagram of the Roche pilot plant for production of rice Premix. (*A*) **motor-driven trumbol;** (*B*) **vitamin solution kettle;** (*C*) **coating solution kettle;** (*E*) **distributor pipe;** (*F*) **perforated section;** (*G*) **compressed air;** (*R*) **white rice**

The Premix plant has been designed to enable it to be installed as an adjunct to the equipment of any medium-sized rice mill. A plant with a 600-lb. batch capacity with a seven-hour run does not exceed $5,000 (U.S.). Such a plant can produce sufficient Premix to enrich 15,000 to 20,000 tons of rice in a year. The plant is easy to erect and does not require special skilled technicians.

In actual operation the amount of added vitamins can be varied to suit local requirements.

This is exemplified in the following two formulae:

U.S.A. AND THE PHILIPPINES

	Enriched rice
B_1	2 mg./lb.
Niacin	16 ,,
Iron	13 ,,

S.E. ASIA

B_1	2 mg.
B_2	1 mg.
Niacin	12 mg.

The additional cost of enriched rice is estimated at $0.40 to $0.45 (U.S.) per head per year.

The value of artificial enrichment

The value of artificial enrichment of flour has been demonstrated in various countries and, following these results, a number of feeding experiments with enriched rice have been conducted on animals and human subjects to determine the effects.

Large-scale experiments were started in the Philippines in 1947 by Dr. Juan Salcedo, director of the Institute of Nutrition, in co-operation with the U.S. Public Health Services, the Philippines National Rice and Corn Corporation, the Williams Waterman Fund and Hoffman-La Roche Inc. The area chosen was the province of Bataan with a population of 95,000 people.

The experiments took the following lines. A survey was made of the entire population of Bataan to determine the existence of beri-beri, the thiamin blood level, the haemoglobin level and the general state of health. This established the basis for comparison with data obtained from feeding with enriched rice. When the survey had been completed enriched rice was introduced into the eastern half of Bataan with a population of 63,000 people. In the remainder of the province, with a population of 29,000 people, no enriched rice was introduced and this area acted as a control.

The test will continue until October 1950, but a first survey commenced in July 1949 has recently been completed. The results of this showed that beri-beri mortality had decreased steadily in the test area as compared with the control and, at the end of eight months, 72% reduction had been obtained; in the control area

the reduction amounted to 14%, which was considered to be due in large part to appreciable amounts of enriched rice having been smuggled in from the test area. It was also recorded that there was no objection on the part of consumers to enriched rice; on the contrary, it was preferred to the normal.

Similar experiments on a smaller scale have been conducted on school children in Singapore by Dr. Oliveiro, Assistant Professor of Bio-Chemistry at the King Edward VIIth College of Medicine, the results of which, as yet unpublished, indicate that riboflavin deficiency is alleviated or eliminated as the result of the consumption of enriched rice. Similar experiments are also in progress in Kuala Lumpur under Dr. R. C. Burgess of the Institute of Medical Research.

The present position

The success of the Bataan experiment has decided the Philippine authorities to extend the use of enriched rice to three additional provinces with a total population of 1,800,000 people, in all of which there is a very high beri-beri mortality, and a plant to manufacture Premix is in course of erection by the U.S. Public Health Services. It will be operated by the National Rice and Corn Corporation. In Malaya and Singapore, Premix is now being offered for sale to consumers and institutions for mixing with white rice. As the Premix contains riboflavin, it is bright yellow and when rice enriched with it is cooked it still retains a faint yellowish tint, but the taste is not affected. Public acceptance of Premix has been good and sales are increasing both to individual consumers and to institutions.

Recently a movement has been launched with the object of requiring that all rice sold should be undermilled rice, parboiled rice or enriched rice which contains prescribed contents of vitamins and minerals. In the U.S.A. the small *per capita* consumption of rice minimises the need for enrichment except perhaps in some parts of Louisiana, Arkansas and Texas, but, nevertheless, several millers are offering for sale enriched, parboiled or undermilled rice.

Summary

The enrichment of rice with synthetic vitamins has proved a practicable and acceptable process in rice-eating regions. It is economical to install and does not require drastic changes in milling machinery or in the dietary habits of the populations. Enriched rice is not objectionable either in taste or in colour, while its keeping qualities are the same as for ordinary white milled rice.

At the first regional conference of the United Nations Food and Agriculture Organisation, held in Baguio in the Philippines in February 1948 on the ' Nutrition Problem of Rice-Eating Countries in Asia,' a resolution was passed to the effect that rice enrichment is considered of value as an immediate measure for attacking deficiency diseases and is expected to prove particularly useful in areas in which beri-beri is an important health problem.

It appears that although rice enrichment does not remove the need for general improvement of diets it does provide an immediate remedy which can be applied in the meantime until re-education brings about a better solution of the widespread dietary problems among rice-eating populations.

Members' Day at East Malling

AT Members' Day at East Malling Research Station, Kent, held on May 3, demonstrations were given of research work in progress on soil management and biennial bearing in fruit cultivation. The programme consisted of tours of the experimental plantations.

Soil management

Mr. D. W. P. Greenham stressed the part played by organic matter in maintaining good soil conditions; it tended to disappear by oxidation and this was hastened by cultivation; it was essential, therefore, to replace it. This could be done by farmyard manure, but now it was necessary to find other materials. He drew attention to a field of blackcurrants where straw, sewage sludge, composted straw and composted town refuse were being tried. Instead of turning in the straw, it can be left as a mulch; a trial of this, using 8 tons of straw with 3 cwt. sulphate of ammonia per acre on blackcurrants, was shown.

As an alternative, research is being directed to cropping, using annual crops, two-year leys or permanent swards. Mr. Greenham considered the best spring annual was mustard sown in spring and turned in at the end of May. The best winter annuals were oats and tares sown in September and turned in by early May, and the two-year leys, lucerne, sainfoin and sweet clover. An interesting annual crop shown was Subterranean Clover, which dies down each summer but reseeds itself by pushing its seed below ground before dying.

He also showed trials of weed-killers compared with straw mulching. The main purpose was to see how safe DNOC in oil emulsion, MCPA and sodium chlorate were for fruit trees. Probably five years would be necessary to assess the effect.

On permanent swards under mature Worcesters, the total crops over the grass strips and the adjoining cultivated strips were equal, but over grass the colour was improved, there was less pre-harvest drop and more fruit fit to market. Furthermore the organic matter in the soil was higher and the plots easier to work. He stressed the importance of a suitable grass mixture, frequent mowing and sufficient nitrogen.

Biennial bearing

Dr. W. S. Rogers introduced the subject of biennial bearing. Regular cropping was of first importance. The worst enemies of this were biennial bearing and frost.

Early workers on biennial bearing had failed to establish causes though work before the war showed that the ' on ' year could be changed by stripping off the blossom. This formed the starting point for new studies. Ways of controlling it were now known, but cheap, practical large-scale methods were needed. Eventually it was hoped to simplify matters by breeding varieties with a naturally regular habit. It was believed possible to identify such varieties by studying their spurs.

Miss Davies showed trees of Miller's Seedling in their ' off ' and in their ' on ' years. The trees had been protected from frost by hessian curtains on frosty nights. Individual spurs had shown great differences in leaf area, and led to experimentally reducing leaf area during the ' off ' year to prevent excessive bud production. The effects of removing a high proportion of fruit buds at the end of the dormant season or by blossom thinning were strikingly shown by trees, treated in 1947, full of bloom, alongside untreated trees in an ' off ' year with no bloom at all.

The part played by fruit thinning in reducing biennial bearing was discussed by Mr. A. P. Preston. In his experiments he thinned the fruit to leave one apple to every 10, 20 or 30 leaves on the tree. He found one to 20 leaves gave the best results; thinning to 10 leaves had scarcely any effect and thinning to 30 leaves depressed the crop unduly without any increased benefit.

Open Day at the N.I.A.E.

THE series of open days at the British National Institute of Agricultural Engineering held on May 24-26 afforded the first opportunity for the public to obtain a general view of the Institution's multifarious activities.

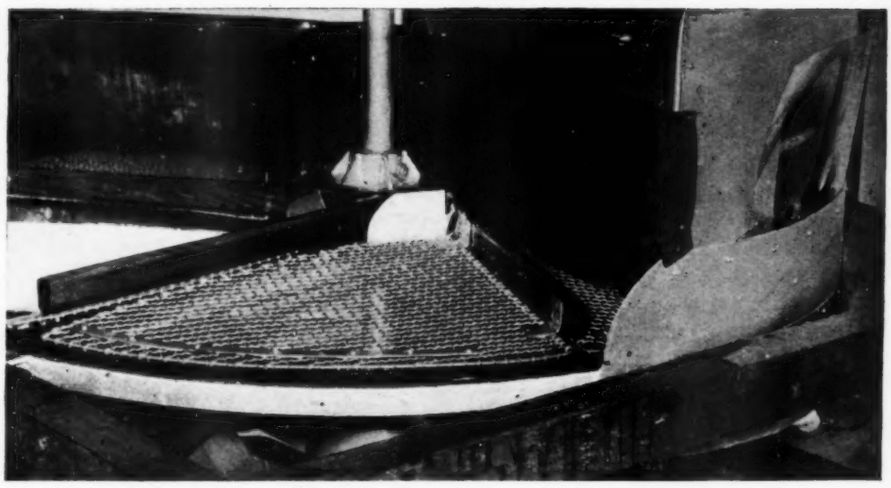
Originally founded as a department of Oxford University and for a time administered as a branch of the Ministry of Agriculture, the Institute is now state-aided under the control of the Agricultural Research Council and administered by the British Society for Research in Agricultural Engineering. It moved to its present quarters at Wrest Hall, near Luton, in 1947.

Briefly, its functions comprise research and development in relation to agricultural mechanisation, the carrying out of impartial tests on implements and machinery as a service to manufacturers and serving as a centre for information on all aspects of agricultural engineering.

At the open days the various lines of activity were demonstrated in a series of admirably displayed exhibits, while the laboratories, workshops and experimental fields were also on view.

It is impossible within the compass of this article to review all the various activities, but some of the more salient aspects are indicated below.

The Bruner onion harvester, an imported machine



Vegetable washing machine for use on smallholdings

The Director (*right*) **of the N.I.A.E., Mr. W. H. Cashmore, with Sir Harold Tempany** (*centre*) **and Mr. Leonard Hill** (*left*)

Development

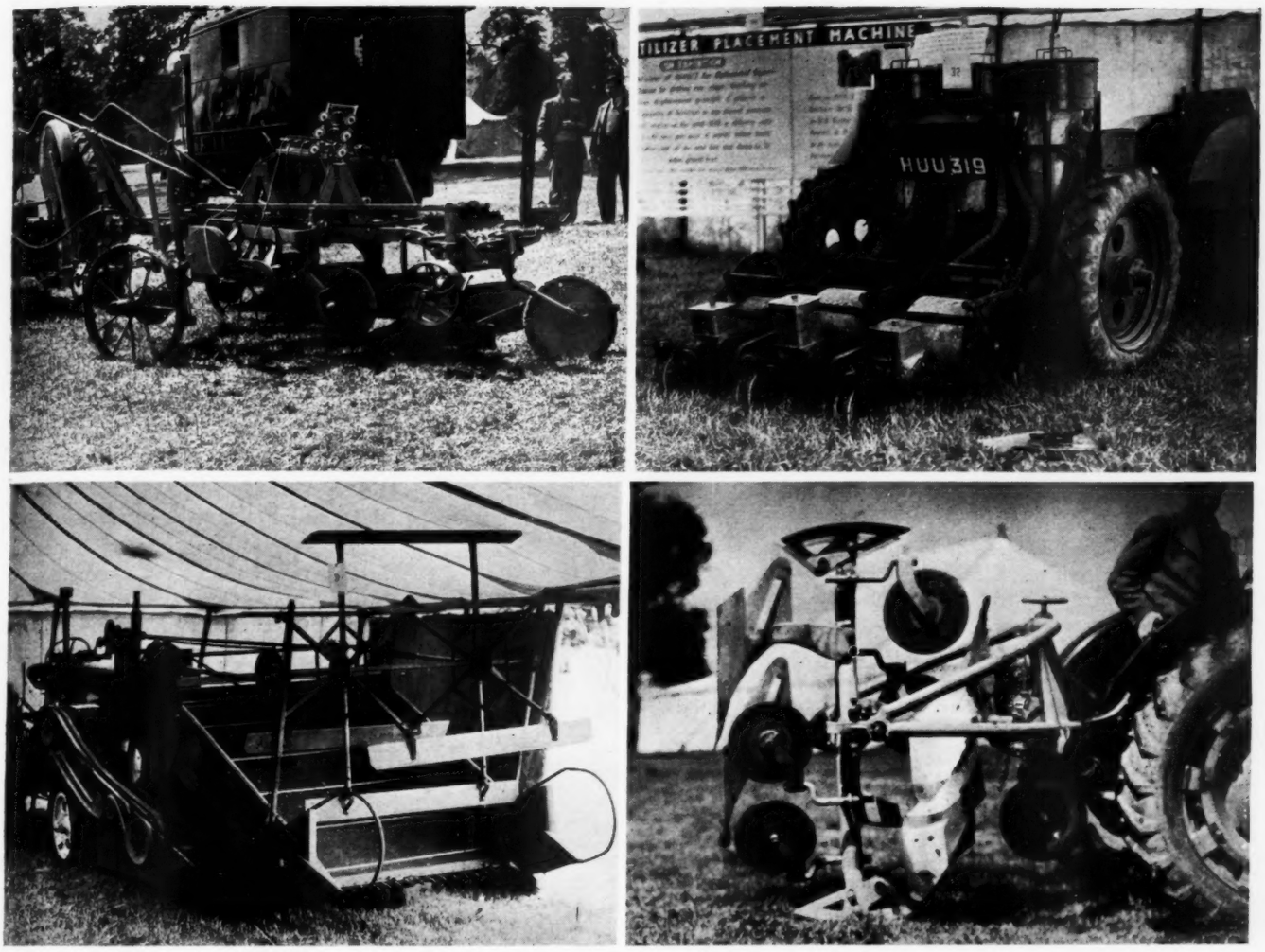
Development work at the Institute is concerned on the one hand with modification and improvement of existing types of machinery or the devising of new machines on an experimental basis, and on the other with designing special testing equipment.

Under the first head, there appeared a new type of one-way mounted plough which reverses itself on the headlands, a modified type of forage harvester, a sugar beet topper-picker which has now reached commercial production and is on the market, a grain cleaner, a grain suction conveyor planned with the object of lifting grain from bins or shallow pits, and vibrating conveyors for granular materials.

Research

There is often a lack of basic information necessary for the development of new types of machinery and the research section is designed to supply this. The exhibits were of particular interest and special mention may be made of the following:

Plough research, designed to throw light on the stresses acting on different parts of ploughs in action in the soil, in which the middle body of the plough is suspended



Top left: **Dynamometer for testing stresses undergone by ploughs in operation.** *Top right:* **A machine designed for research in fertiliser placement at Rothamsted.** *Bottom left:* **Miniature combine harvester for work on experimental plot. The machine is pushed by a tractor.** *Bottom right:* **New type of one-way mounted plough, which reverses itself on headlands**

by strain-gauge dynamometers which measure electrically and the results are recorded photographically in a recording vehicle alongside.

Frost fans, already described in this journal (Vol. 2, page 208), which consist of horizontal fans designed to bring down warm air lying over frosted ground and thus protecting orchards from late spring frosts.

Precision planting trials, designed to examine the use of mechanical gappers and thinners in conjunction with precision planters and the use of pelleted seed; in the latter connection methods of pelleting seed were also demonstrated.

Investigations on vegetable drills. It has been found that variations in speed, site, size, mechanical construction and rate of vibration are all decisive factors in this connection.

Other interesting exhibits were the machine designed and made by the Institute for carrying out fertiliser placement trials at Rothamsted Experimental Station and a pusher type of combine harvester, originally designed for harvesting on separate experimental plots. This attracted much attention and it seems possible that it might prove a forerunner to a machine which could be used commercially for harvesting small areas.

Horticulture

The horticultural group deals with problems of the mechanisation of growing of fruit, flowers and vegetables, including the evolution of forms of horticultural tractors adapted to particular requirements, methods of steam sterilising soil, and bulb-planting experiments in which the angle at which the bulbs are planted was varied.

So far it seems that unless bulbs are planted upside down the angle at which they are planted has little effect. In addition a small vegetable washing machine suitable for use on smallholdings was shown.

Exhibit of imported machinery

A feature of the show was the exhibit of some 18 agricultural machines of different types imported from foreign countries. From time to time machines appear which might be of benefit to farmers in this country, and these are acquired and tried out by the Institute. Among those exhibited, special attention was attracted to the Allis Chalmers '60' combine harvester, the Bruner onion harvester, the Scott Viner red beet harvester, the Lanz potato spinner (a German machine) and the Roto-ette power gardener and implements which showed a remarkable degree of versatility.

Testing section

The testing work at the Institute is of particular interest. Manufacturers of machinery are able to have tests made on agricultural machines or appliances ready for commercial production. The tests are

carried out at an agreed station and from the results a report is furnished to the makers of the machine which can be published. It is interesting to note that close on 400 makers of machinery have already taken advantage of the service and the machines tested include tractors, ploughs, cultivators, direct-mounted implements, seed drills, manure spreaders, hammer-mills and many others. The tests comprise not only measurements by the use of specialised apparatus but also practical field tests carried out under farm conditions.

N.A.A.S. liaison unit

In order to ensure that close touch is maintained with the farming community in all parts of the country a liaison service is maintained through the local officers of the National Agricultural Advisory Service; enquiries from farmers go through the country or provincial machinery advisors to the N.I.A.E., which the Institute publishes in numerous reports, leaflets and bulletins; in addition it arranges refresher courses to enable machinery advisors of the N.A.A.S. to keep up-to-date with recent developments. By this means a two-way flow of information from the Institute to farmers and from farmers to the Institute is maintained.

General

The open days were well attended. There is no doubt that the Institute is performing a much-needed service and that its utility is bound to increase as the years go by. It is in many ways unique and it is to be noted that its services can be made available not only for people in this country but, through appropriate channels, to workers overseas.

Hill Country Grasslands

(*Concluded from page* 292)

female animals that beget the lambs for fattening in the lowlands. This is a great benefit to the lowlands, but the animals take with them from the hills potash, phosphate and lime in their skeletons and body structures, and tend to deplete the hills of their essential plant food. In the past little or no consideration has been given to the need for replacing these annual losses, nor has it been recognised as demanding higher prices in order to enable replacement of the essential fertiliser ingredients. It may be that price enhancement *per se* is not the best way to ensure return of fertility to the hills. A possible alternative might be the establishment of pools to which the lowland farmer and the nation contribute, which would be used to subsidise fertilisers and other commodities for use on the hills.

New Crop Projects in N. Central U.S.A.

M. M. HOOVER

Regional Co-ordinator, North Central Plant Introduction Station, Ames, Iowa

More than 75% of the commercial crops grown in the United States originated in foreign countries. The need for further introduction continues and to provide the necessary facilities and control the United States Department of Agriculture established the Primary Plant Introduction service. In the following article the author describes the work of the recently created Station at Ames, Iowa, which forms a part of this service.

THE provisions of the Research and Marketing Act of 1946 (Public Law 733—79th Congress) have enabled a healthy and rapid expansion of research to encourage the discovery, introduction and breeding of new and useful agricultural crop plants.

Plant introduction is a borrowing process that has long played an important role in expanding the agricultural wealth of the human race. Its origin began with the nomadic wonderings of early people in their search for new homes and favourable soils and climates adapted to their livestock needs and food-producing crops.

Colonial plant introduction

Settlement in America followed this same course and we find repeated statements in early colonial history that the crops and culture of Europe very definitely characterised the beginnings of agriculture in the New World. The growth and development of agriculture of the continental United States is the direct result of the introduction of plants from foreign sources. These plants have been selected and adapted to our many and varied climates and needs by plant scientists and farmers; first, largely by trial and error and later by carefully planned and organised experiment.

Throughout the years, the knowledge and experience gained by farmers and ranchers, together with the improved technology developed through organised research by state and Federal Experiment stations, constitutes the 'know how' of progressive agriculture in America.

State and Federal co-ordination

The Federal Government, especially through the efforts of the Department of Agriculture, has long been interested in the matter of plant introduction. More than 75% of the crops now grown commercially in the United States had their origin in foreign countries.

The Research and Marketing Act of 1946 provided the necessary funds and initiated an era in American agricultural organisation whereby the co-ordinated effort and facilities of State and Federal governments are directed toward the discovery, introduction and breeding of new and useful agricultural crop plants.

The national new crops project is centred with the Division of Plant Exploration and Introduction of the Bureau of Plant Industry, Soils and Agricultural Engineering at Beltsville, Maryland. This Division conducts foreign and domestic explorations for new and useful crops. During the past three years, five foreign and three domestic expeditions have returned approximately 12,000 plant introductions to the United States for evaluation and use in this new research programme. In addition, many plant introductions have been obtained by direct exchange and purchase from research workers and foreign correspondents.

Organisation

For purposes of administration, the new crops project is organised on a co-operative basis with the various state experiment stations grouped on a regional basis as North Eastern, North Central, Southern and Western. This discussion will be confined to the new crops work of the North Central Region that comprises the states of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota and Wisconsin.

A regional technical advisory committee, consisting of one experiment station staff member appointed by each state experiment station director, provides technical guidance for the project, prepares the annual budget, recommends research projects, suggests new crops of interest and regions for plant explorations. Each member of this committee also serves as chairman of his state or local experiment station staff committee which represents all divisions of the state experiment station staff interested in plant research. Hence, each state advisory committee member represents his local research workers in forestry, horticulture, botany, pathology and agronomy or other phases of plant research.

North Central region

The Primary Plant Introduction Station at Ames, Iowa, representing the North Central Station, serves as general headquarters for the propagation of new crop materials for these 12 states. In addition, secondary stations may be located at specific state experiment stations where special requirements must be met for plant adaptation. The primary Station has a co-ordinator, technical staff, and propagation facilities consisting of land, greenhouse and field equipment to increase seed of new introductions and make initial evaluation of the plant material.

The co-ordinator directs the work at the Primary Station, and in addition, through personal visits to the crop project leaders in the several states, serves to co-ordinate the research work concerned with detailed evaluation and use of new introductions in plant improvement and breeding programmes. The co-ordinator is responsible for maintaining a current record of the performance of new accessions as they are received and evaluated by the several state research workers. A regional inventory comprised of plant species and breeding stocks of known and proven value in use by research workers of the several states is being compiled by the Primary Station.

Seed storage facilities of the Primary Station having controlled humidity and temperature are used to maintain the breeding stocks and the new introductions under optimum storage conditions.

During the past year the Primary Station has received more than 4,000 of the total of 12,000 introductions that were brought into the United States under this co-ordinated programme. Approximately 2,000 of these accessions were grown in 1949 for seed multiplication and initial evaluation. Special precautions were used to maintain identity and prevent loss of genetic composition of the original material as introduced. For example, all wind or insect pollinated species were increased by sib-pollination or by use of bees and cages. Forage legumes and grasses were increased by clonal propagation.

Increase seed and initial field observational notes taken during the seed increase year are assembled in a seed list and distributed to state research workers for careful evaluation and use in their respective plant improvement and breeding work.

The Primary Station assumes the responsibility for maintaining reserve seed of each accession, thus relieving the state research worker of maintaining seed supplies; in return the state research worker reports performance of a given accession to the Primary Station where such information is posted currently on the accession record.

Plant introduction propagation house, Iowa State College

The future

Although the new crops project in the North Central Region has completed but one season, we are encouraged to believe that the facilities and procedure give promise of great stimulation to the work of plant evaluation and research. We are particularly pleased with the response of research project leaders in the several states toward this co-ordination of effort through the Primary Station.

Agricultural Exhibits at the BIF

The British Industries Fair was held at Earls Court and Olympia in London and at Castle Bromwich in Birmingham from May 8-19. In such a vast concourse, representing every branch of British industry, it is probably not surprising that agricultural aspects did not play a very prominent part, bearing in mind that the appeal is directed mainly to overseas buyers and that the emphasis is laid more particularly on manufactured articles for direct consumption.

Nevertheless, a number of agricultural exhibits appeared. At the Olympia section, which included in its scope chemicals, drugs and scientific instruments, there were a number of exhibits from manufacturers of insecticides, fungicides, weed-killers and similar materials, as well as scientific apparatus used in connection with farming operations. The exhibitors included, among a number of others, Imperial Chemical Industries, Pest Control Ltd. (who featured the new systemic insecticide, *Pestox III*), Shell Chemical Manufacturing Co. and Hemingway and Co.

At Castle Bromwich, where the display was mainly concerned with heavy machinery of all types, there were about 50 stands covering a moderately wide range of machinery and appliances used in agriculture, although the majority of the larger firms manufacturing agricultural machinery, tractors and implements in this country were not represented.

As in previous years the Commonwealth section, in which a number of the dominions and colonial dependencies staged displays illustrating their resources, was a special feature and, in these, agricultural products and resources played naturally a prominent part. Canada, the Union of South Africa, India and Pakistan all had representative displays, while among the colonial dependencies exhibits appeared from the West Indies, Nigeria, the Gold Coast, Sierra Leone, Malaya, Cyprus and Malta.

Field Crops and Fruit in South Africa – 1949

Last month we published some extracts from the Annual Report of the Department of Agriculture in South Africa for 1949. In this concluding article the Union's field crops and fruit production are reviewed.

Maize

THE maize crop for the 1948-49 season reached a total of 32,119,496 bags. This is the largest crop yet obtained in the Union and can be ascribed mainly to the favourable weather conditions during the growing season. Together with a carry-over of 2,300,000 bags held by the Mealie Industry Control Board, the country had a total of approximately 34½ million bags of maize at its disposal.

The control system which has operated since 1944 was continued during the 1948-49 season. Under this system the Mealie Industry Control Board, through its agents, is the sole buyer of maize from producers in area 'A', *i.e.* the area comprising the Transvaal, the Orange Free State and the Mafeking and Vryburg districts in the Cape Province. In the rest of the Union, known as area ' B,' maize is purchased by registered maize traders who are free to dispose of such purchases, subject only to the price control regulations. The Mealie Industry Control Board purchased approximately 23,200,000 bags of maize from producers in area 'A,' of which some 2,401,000 bags were deposited in the elevators. It became clear during the 1948-49 planting season that climatic conditions were so unfavourable that the coming crop would be considerably smaller than that of the previous year. The Government decided at that stage that no further quantities would be exported, and the Mealie Industry Control Board therefore carried 6,000,000 bags over to the 1949-50 season. The carrying over of such a quantity of maize from the past season in itself gave rise to difficulties, since these supplies were concentrated with a limited number of agents of the Mealie Industry Control Board. Due regard had to be paid to damage by weevils, and special steps had to be taken to ensure that the maize carried over from the previous season was consumed first, although new maize became available from producers early in May and June 1949. In consequence of the whole-hearted co-operation of millers and other consumers the carry-over was consumed before any serious damage occurred. It may be added that a considerable portion of the 500,000 bags of maize sold to Southern Rhodesia came from these supplies.

Wheat

The wheat crop for the 1948-49 season was of fair size, but it fell short of the original estimates.

The Union's supply position at the end of the previous season, coupled with improved prospects for the importation of wheat from overseas, rendered possible during the year under review the reintroduction of white bread and white meal and also the lifting of the various restrictions introduced in April 1941 for the conservation of wheat.

At the end of the previous (1947-48) season, a considerable quantity of imported wheat had accumulated at the Union's ports and further supplies arrived during November-December. The fact that these quantities and the Union's crop arrived almost simultaneously rendered the storage position extremely difficult, especially since the presence of large quantities of maize in the hands of agents and in the grain elevators had already created a critical position. The Wheat Board was successful, however, in solving these difficulties.

During the period under review the Wheat Board, in collaboration with the Stellenbosch-Elsenburg College of Agriculture and certain producers, inaugurated a scheme under which selected mother seed is being propagated under strictly controlled conditions and the crop obtained is selected and sold as certified seed. In its initial stages, the scheme will be very limited in scope, but the Board intends applying it more extensively as soon as circumstances permit.

During the year the Union signed the International Wheat Agreement as an importer and so became a member of the International Wheat Board.

Owing to increased bread consumption, almost one and a half times as much wheat is being milled in the Union at present, as compared with pre-war days, and there is therefore a proportionate increase in the quantity of available bran. Almost all this bran has been absorbed by the local market and only a small surplus of approximately 10% of the production was exported at the same or slightly higher prices than those fixed.

Other cereals

The control of barley, oats and rye introduced in 1942 as a war measure was again exercised by the Wheat Board during the period under review. In terms of this measure producers are prohibited from supplying barley, oats and rye to any person other than the Wheat Board, and the Minister fixes the grades as well as the purchase and selling prices of these cereals, and also the grades for rye flour, rye meal, rye bran and rye bread, crushed oats and ground oats. The Wheat Board fixes the prices of rye and oaten products in consultation with the Minister.

Barley

Owing to the shortage of barley, the order of precedence of the various requirements had to be determined, and it was decided to meet the seed and yeast requirements in full, while approximately 80% of the requirements for beer and pearl barley were supplied. The sales were as follows:

Purpose	*No. of bags*
Yeast, malt meal and malt extract	22,600
Pearl barley	38,500
Beer	176,891
Seed	29,000
Feed	2,060
Sundries	433
Total	269,484

Oats

During the 1948-49 season the following prices were paid to producers for oats:

Class A, grade 1 . . 15s. 9d. per bag of 150 lb. nett
Class B, grade 1 . . 15s. 3d. per bag of 150 lb. nett
(*The prices of the lower grades were in proportion*)

Groundnuts

Owing to the dry growing season and the consequent increased incidence of diseases and insect pests, the year's crop was smaller, in spite of the fact that a larger

This is the Paarl Valley in the Cape Province, headquarters of the viticultural industry. In the foreground are the big vineyards of a typical Huguenot farm

area was planted to groundnuts. The quality was also poorer. For the twelve months ended August 31, 1949, the agents of the Directorate of Food Supplies and Distribution took in approximately 43,464 tons of groundnuts as compared with 46,228 tons for the same period last year when the total crop was 57,011 tons.

In order to safeguard the country's oil requirements and ensure supplies of oil cake, the Government decided to guarantee £58 10s. per ton for the entire crop. At the same time arrangements were made with the expressors whereby they agreed to take 30,000 tons of the groundnut crop and to express the balance for the Government's account.

As in the case of groundnuts, sunflower seed was also placed under the distribution control of the Director of Food Supplies and Distribution and the producers' price was fixed at 20s. per 100 lb. for first-grade sunflower seed. Owing to the drought, the sunflower crop which had initially been estimated at 60,000 tons proved very disappointing and some 25,000 tons only were eventually available for expressing purposes.

Potatoes

Plantings, especially on the Transvaal Highveld, exceeded those for the previous year, but due to the widespread droughts, considerable damage was done in the Transvaal and Orange Free State with the result that the crop was actually only a portion of the expected crop under normal circumstances. (*See table*).

The winter crop for 1947-48 was estimated at 440,000 bags and the 1948-49 winter crop was considerably better.

The fact that the main crop, namely that of the Highveld, was of rather poor quality, worsened the position during the summer months. In that way the utilisation of a weakened crop was further affected. The quality of the limited Free State crop was, on the other hand, excellent and could, therefore, be used to good advantage. Fortunately the Lowveld with their winter production commenced marketing at a fairly early date in 1949. This area was, therefore, able to contribute towards restricting the rising price tendencies, especially on the northern markets.

Seed potatoes

During the year no export of seed took place. It was expected that the position as regards seed for planting during the coming season would not be easy. The general droughts had also affected seed production detrimentally, with the result that *in toto* a two-third crop only was expected.

Because of the foreign exchange difficulties the Department fixed a quota for the importation of seed, which represents approximately two-thirds of the normal average annual importation of the past number of years.

At the request of the South African Seed Potato Growers' Union, a joint committee, consisting of two members of the Potato Board and two members of the Union, was created to make propaganda for the use of certified seed. The greater part of the cost of the campaign will be borne by the Board.

Vegetables

As will be seen from the figures below, which reflect the quantities of seven of the main kinds of vegetables sold on the eight principal municipal markets of the Union, there was an increase in the sales and the data give a fair indication of the increase and decrease in production of the vegetables concerned during the past two seasons:

The seven kinds of vegetables are those indicated and the eight municipal markets are Pretoria, Johannesburg, Bloemfontein, Cape Town, Port Elizabeth, East London, Durban and Pietermaritzburg.

Although the total quantity of these seven kinds of vegetable sold in 1948-49 was only slightly higher than in the previous twelve months, there was a fair increase in the quantities of onions, tomatoes and green beans, while there was a fair sharp decline in the sales of sweet potatoes and green peas.

VEGETABLE PRODUCTION

	1947-48		1948-49	
	Quantity 1,000 *lb.*	*Value* £1,000	*Quantity* 1,000 *lb.*	*Value* £1,000
Onions	50,363	442	52,004	426
Sweet potatoes	35,793	127	28,328	159
Tomatoes	85,734	782	92,559	898
Green beans	16,009	192	18,676	235
Green peas	19,385	252	17,923	283
Cabbage	58,800	220	57,082	283
Cauliflower	12,227	75	12,471	84
Total	278,311	2,090	279,042	2,368

POTATOES:—SUMMER CROP

	Crop estimate in bags of 150 *lb.*		
	1946-47	1947-48	1948-49
Transvaal	1,952,000	1,829,000	1,634,000
Orange Free State	923,000	673,000	350,000
Cape Province	525,000	491,000	505,000
Natal	336,000	275,000	287,000
Total	3,376,000	3,268,000	2,776,000

Tobacco

The tobacco yield for the past crop year was the highest in history, viz. 49,634,000 lb., compared with the previous year's bumper crop of 39,714,000 lb. This increase may be attributed mainly to favourable climatic conditions and the absence of early frost.

The total consumption during the calendar year 1948 rose by 3.4%, *i.e.* from 35,921,000 lb. in 1947 to 37,147,000 lb. in 1948. The production level of the past two years was therefore considerably higher than the average annual consumption and with adequate supplies on hand a market will have to be found outside the Union for the surplus. Since, however, the nett price obtained overseas for tobacco is somewhat less remunerative than the local price existing, tobacco farmers and prospective tobacco farmers are warned against glutting the limited South African tobacco market.

Deciduous fruit

The peach, pear and grape crops for the past season were good. The plum production, however, was approximately 30% below normal. Apricots and apples were again handled by the Board.

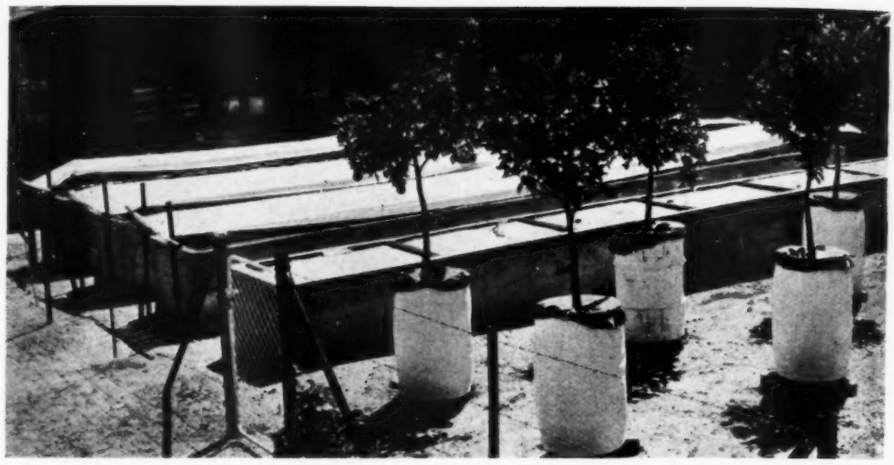
Exports to the United Kingdom and other countries reached the record total of 103,000 cubic tons for the season, an increase of 18,000 cubic tons on the pre-war average exports of 85,000 cubic tons. Though ceiling prices were again established overseas, results were satisfactory.

The total quantities of the various fruits (in tons) handled were as follows:

	1947-48	1948-49
Apricots	338	658
Peaches	1,345	1,081
Plums	6,513	3,772
Pears	20,208	16,955
Grapes	40,296	40,511
Apples	3,165	3,967
Total	71,865	66,944

The other channels through which fruit is absorbed have again taken the full quota. Prices of dried fruit were maintained at the level of the previous season and in some cases even showed some improvement, but despite this, production declined. Labour shortage forces the producer to market his fruit fresh and cases have even occurred where the fruit was sold on the tree, the purchaser undertaking to do the picking himself.

Raisin production was maintained at more or less the 1948 level, which has allayed the fear that attractive wine prices would cause production to shrink. It is doubtful, however, whether the industry will be able to maintain this production in future.



The plant pathology quarantine section at the subtropical horticultural research station, Nelspruit, E. Transvaal. These citrus trees are being grown in pure quartz sand to which nutrient solution is added

Commercial drying yards have more or less attained their previous turnover, but these undertakings find that factory wages curtail their activities, since the farmer is able to get the work done at an appreciably lower price.

Despite fears concerning the market for Thompson's seedless raisins, overseas markets offered good prices and production reached a new record of 2,000 tons.

Citrus fruit

The 1949-50 crop is estimated at approximately 5,200,000 cases of export quality and, of this, 1,780,797 cases of oranges, 431,155 cases of grape fruit, 25,704 cases of lemons and 282 cases of naartgies had been exported up to August 31, 1949.

Although the estimated crop for this season is slightly more than last season and approximately 85% of the normal crop, the Citrus Board once again decided to retain 25% of the exportable crop for sale in the Union in order to ensure that local markets in the Union would receive adequate supplies.

The fact that the 1949-50 citrus crop will be only about 85% of normal may be attributed partly to the after-effects of the drought during the past three seasons and partly to the lack of adequate supplies of nitrogenous fertilisers during those years. Although most citrus nurseries are now again producing trees on a fair scale, the output for the next few years will not be sufficient to meet the demand.

The normal demand for, and consumption of, citrus fruit in the Union continues to represent roughly 50% of the normal production, and the industry, therefore, remains largely dependent on an export market.

As reported last year, a survey has been undertaken by the Citrus Board to determine the possibilities of expanding citrus plantings to the fullest extent. That survey is now completed and, from the information obtained, it is clear that there are large areas where climatic conditions are favourable for citri-culture, the soil suitable and water for irrigation purposes sufficient.

Appreciable expansion of the industry is not taking place. The main reason for this may be attributed to the fact that the profits made on vegetables, sugar, soft fruits, tropical fruits and tobacco have, in recent years, been considerably higher than those on citrus fruit, with the result that land suitable for citrus production is being utilised for growing those more profitable and, in most instances, relatively short-term crops.

Sub-tropical fruit

Except in the case of two kinds, there was a general increase in the quantities of eight of the main kinds of sub-tropical fruits sold on the eight principal municipal markets in the Union during the year. It must, however, be pointed out that a large proportion of this fruit is not marketed by the municipal markets, especially in the case of Durban where the local Indian market handles most of the tropical fruit.

All tropical fruits were reasonably well supplied except bananas, which at times were particularly scarce. Owing to import restrictions and the fact that the local production is not sufficient to meet the demand the prices of bananas started rising sharply in January 1949, and it was decided to fix the maximum price of bananas at 1s. per dozen.

Viticultural products

Climatic conditions in the early spring of the 1948 season were ideal and every-

thing pointed to a bumper crop. At the end of October, however, several areas experienced severe frost and the vineyards in the Montagu and Ladismith localities received a setback. Only a small portion of the entire viticultural crop is, however, produced in these localities and the prospects for the crop as a whole were therefore not affected. In consequence of abnormally low rainfall in the early summer, accompanied by exceptionally hot weather, the grapes could not ripen normally and had a lower sugar content than usual. Despite these unfavourable conditions, the total grape crop amounted to 30,511 leaguers more than that of the previous year.

Labour continues to be a real problem and farmers are still obliged to establish co-operative wine cellars in order to cope with the serious labour shortage during pressing time.

Although it is difficult to obtain adequate supplies of fertilisers, the position has nevertheless shown some slight improvement since last year.

In contrast to the increasing demand for brandy and other spirits it would seem, however, that the demand for and consumption of good wine is decreasing. This supposition is further confirmed by the supplies of good wines which wholesale liquor dealers had on hand on December 31, 1948, viz. 10,500,000 gross gal., which may normally be regarded as equalling a year's consumption. This means an increase of 1,500,000 gross gal. in comparison with supplies on hand at the end of 1947 and this despite the fact that approximately 1,360,000 proof gal. of spirits or brandy out of their 1947 and 1948 purchases of good wine were distilled in terms of grants made under pool regulations. At present there is, therefore, a surplus of good wines and a shortage of brandy and wine spirits.

Under the pool regulations farmers are able to carry over their unsold good wines to the following year, but in most cases such a carry-over is not possible, since farmers are forced by a shortage of storage space to deliver their good wine as distilling wine before the end of the year.

Co-operation Increasing in England

At the fifth annual general meeting of the Agricultural Co-operative Association, held in London recently, the chairman, Sir Frederick Brundrett, said that the annual turnover of the ACA had increased from £26 million to nearly £50 million since its inception in 1945, and 147,000 farmers in England are now served through co-operative societies, which now number 103.

First Results from Food Corporation's Sorghum Project

Carcases of steers fattened on sorghum stubbles at Peak Down, Central Queensland

On May 4, 1950, the Overseas Food Corporation arranged a display of part of the first consignment of 100 beef carcases from the estates of the Queensland-British Food Corporation at the Union Cold Storage Co. Ltd., London.

These carcases of steers were fattened on sorghum stubbles, the steers being purchased during the latter part of March 1949 and drafted to one of the Queensland-British Food Corporation's estates during April and May for age and uniformity. The animals were mostly 2 to 2½ years' old. Five hundred steers, all Herefords with the exception of 50 Shorthorn Hereford Cross, were placed on sorghum stubble grazing on June 20, 1949. At that stage they were in fair store condition and came off dry winter pasture. A big percentage had travelled 500 miles on the hoof. They quickly adapted themselves without any ill effects and, after two weeks, the improvement in condition was noticeable and after six weeks most marked.

The grazing consisted at first of the coarse stalks left after harvesting and a sparse ratoon growth, together with heads of grain which had fallen away from the harvesters or lodged owing to frost.

Despite bitterly cold weather the steers thrived between June and October. They were moved three times onto different paddocks of stubble, the average range being 2,000 to 2,500 acres. Following the early rains in October, there was a rapid flush of young sorghum on which the cattle did very well, although there was a slight softening in condition on the young feed. The cattle were actually doing their best during what are recognised as the worst months of the central highlands of Queensland, namely July, August and September.

The fat bullocks were sold to the Central Queensland Meat Export Co. in early December at an average of 3 to 3¼ years' old, and dressed out at an average of 650 lb. It was the general opinion of trade experts that the beef was ' good butcher's beef ' with a fair proportion of lean meat and not too much fat. The fattening of cattle on sorghum stubbles has proved most successful and, in addition to its primary purpose of providing feeding stuffs for pigs, the growing of sorghum will help greatly to increase the production of beef in Australia.

Representatives of the meat trade, the Australian Meat Board, the Ministry of Food, the Ministry of Agriculture and Fisheries and the Overseas Food Corporation were among the visitors to the display. It was the general opinion of trade experts that the beef was ' good butcher's beef ' which would be liked by housewives because there was a fair proportion of lean meat and not too much fat. Mr. R. H. Heywood, Commonwealth Veterinary Officer, Australia House, and London representative of the Australian Meat Board, said of the carcases, ' This is the nicest run of beef I have seen for a long time from Australia.'

(See WORLD CROPS, 1, 1, pp. 28-30, 'Sorghum in Queensland.')

NEW BOOKS

Sheep Husbandry

By Allan Fraser. Pp. xii and 297. Crosby Lockwood, London, 1949, 25s.

This book, like all of Dr. Allan Fraser's writings, is extremely readable, yet full of information on the very wide subject of sheep husbandry. In his preface the author explains that he wanted to attempt 'a conciliation between the traditional knowledge of shepherding learnt in my youth and the scientific studies I have indulged in later in life.' In doing this he has not only produced a valuable and informative book, but one that is highly stimulating and intensely interesting.

Dr. Fraser fears the dogmatism of modern science as applied to agriculture. 'When there is conflict of opinion between scientist and practical shepherd it is too often assumed that the shepherd is necessarily wrong. The facts are that an intelligent, observant and experienced shepherd or flockmaster knows far more about sheep, as sheep, than any scientist, simply because he has studied the sheep as a sheep, as it really is, as an integrated unit and not as a mere collection of analysed parts.'

Throughout the book he has drawn freely on his own practical experience and observations. Many of the results of research concerning breeding, production and nutrition of sheep are discussed and explained in a lucid way, easily understood by the practical man. The student will find much of value in this book, and the comprehensive list of references classified according to subject is particularly useful.

The book begins with a chapter on the sheep trade of the world, followed by a description of sheep breeds, including those of other countries outside the British Isles. So often in books on animal husbandry, the chapter on breeds becomes a mere catalogue of standards of excellence, with no attempt to discuss the more important characteristics of a breed and their relation to practice. This cannot be said of Dr. Fraser's book, for he has devoted a considerable amount of space to showing how and why various breeds fit into the pattern of sheep production systems in different countries.

Sheep have a very close dependence on pasture and in discussing this aspect of sheep nutrition, the author deplores the fact that much grassland research has become an independent study concentrating on production. This, he says, 'has resulted in a tendency to give greater consideration to the grass than to the stock that graze it . . . A pasture that can only be maintained in excellence by remaining ungrazed at the times of year when stock need grazing most is not excellent pasture at all. The real problem of all pasture as a basic food is its seasonability.'

By their calling, shepherds tend to be philosophers. Philosophy, practical experience and scientific knowledge have been combined in producing an extremely interesting and valuable work.

A. J. BROOKES.

The Principles and Practice of Cider-Making

By Vernon L. S. Charley, Ph.D. Translation of 'La Cidrerie' (by G. Warcollier). Pp. 367. Illustrated. Leonard Hill, London, 1949. 35s.

There has long been a need for a book in English giving a thorough account of the principles and practice of cider-making. This need has now been satisfied, and admirably so, by Dr. Charley's translation of the third and last edition (1928) of the late Professor Warcollier's book 'La Cidrerie.' The fundamental processes of cider-making, so adequately described by Warcollier in 1928, remain essentially unchanged today, and the translator has also drawn freely upon his own wide knowledge of present-day practice so that his book is both authoritative and up-to-date. It is peculiarly appropriate that this book, written by the French 'master of cider-making,' should have been translated by Dr. Charley, since the latter's study of the subject at the Research Station, Long Ashton, together with his close association with the industry in this country and his first-hand knowledge of the French, Swiss and German methods of cider-making, have ably fitted him for this task.

Following a brief historical introduction is a review of present-day French cider statistics, including valuable data on the utilisation of French cider apples and the relative importance of the respective outlets for this crop. This is followed by a short account of the composition of the apple, after which methods of storage of apples to mature for pressing are described. In the Translator's Addendum at the end of this chapter (most chapters have such an addendum, and this is an exceedingly valuable feature of the book) a list of the cider apple varieties *now* officially recommended for planting in this country is given, and also a note on bush cider apple trees and mention of Dominion varieties.

Extraction of juice from the apple is comprehensively dealt with in the chapters on milling, pressing and preliminary purification of the juice—and these chapters are some of the most informative and valuable in the book. The processes of diffusion, maceration and defecation (keeving), the latter two of which are so widely practised in France, are described with that clarity of expression that comes only with long experience.

The text of these chapters and indeed throughout the whole book is admirably illustrated by well-chosen and well-reproduced photographs and diagrams.

Clarification (both during and after fermentation) and fermentation by the yeasts naturally present or by selected yeasts are comprehensively described, although the description of fermentation by the latter method (so widely practised in Switzerland) is not quite of the same high standard as the text in the remainder of the book.

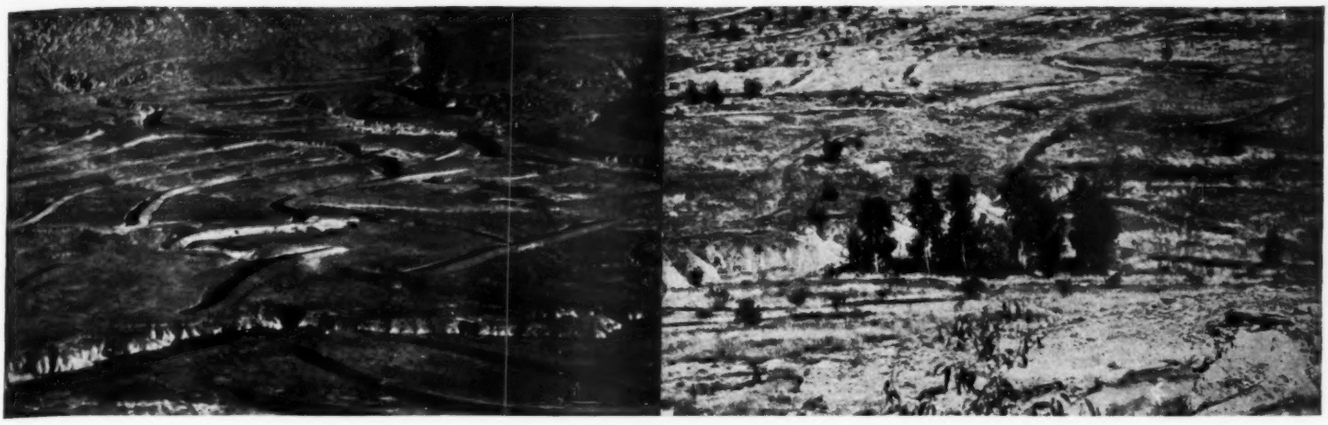
A most interesting account is given of special methods of cider-making and a complete chapter is devoted to sweet cider (a type very popular in France) including the production of *naturally* sweet cider and of cider sweetened by the addition of unfermented apple juice.

Other aspects of cider-making described include the manufacture of sparkling ciders; composition, analysis, disorders and transport of cider; French Food Regulations concerning cider and perry.

The chapter on unfermented apple juice and concentrate will undoubtedly stimulate interest in these related apple products and thereby assist in the more complete utilisation of our apple crops. The important by-product, apple pomace, and its value as a source of pectin and as a foodstuff for livestock is fully described. The book concludes with a description of the distillation products of cider, an industry of some importance in France.

Dr. Charley's book will be of real interest and value to all those concerned with the production and utilisation of our cider apple crop and to the manufacturers of the plant and equipment used in the production of cider, apple juice and concentrate. In particular, to cider manufacturers, farmer cider makers and others directly interested in the many fundamental problems associated with cider-making, the book should serve as a standard reference. Dr. Charley writes as a master of his subject and is to be congratulated for this most welcome addition to the literature of cider-making.

S. W. CHALLINOR.



Left: **A badly eroded area in Basutoland which has recently been protected with contoured bunds.** *Right:* **The same area four years later, when erosion has been checked and the area is heavily grassed**

The World Problem of Erosion

Soil Conservation in the British Colonies

Soil erosion today is one of the most serious problems confronting agriculture. It has many aspects and it is our intention to present some of them to our readers in this and succeeding issues. The following article is a condensed version of a lecture recently delivered before the Royal Society of Arts, and is reproduced by permission of the Society.

BRIEFLY stated, soil erosion, concerning which so much has been written and said during recent years, is the result of the removal of soil, particularly the finer particles, by moving water and by wind, and is a natural process which is responsible for the sculpture of the landscape. Normally it is held in check by the vegetational cover, soil losses being balanced by gains from rock weathering. It is only when the losses are accelerated by excessive removal of the vegetational cover and by injudicious land use that it becomes dangerous. The effects are greatest where rain comes in heavy falls, or when high winds are associated with prolonged dry spells, notably in the tropics and subtropics and on the prairies and steppes of continental regions; these may conveniently be called erosion-prone regions. Where climates are mild and rainfall less intense, the dangers are less, though not entirely negligible.

Sheet erosion is the most important form, due to the removal of surface soil by moving water, especially the finer particles containing most of the available plant food; the magnitude of the effect varying with the slope. The early stages are not obvious and the first observed effects may be falling crop yields. Gullying is the culminating spectacular form; before it is reached almost irreparable damage may have been done. Wind erosion, with its accompaniment of dust storms, soil drift and shifting sand dunes, can be very destructive in regions of low rainfall. In erosion-prone regions, farming practice and land use should be adapted to suit the conditions and minimise the dangers. It follows that erosion is a symptom of wrong land use and its control consists in ensuring that the land is used correctly. The risks have always existed; erosion is not, as some might imagine, a new and sudden threat to human existence.

Reasons for increased erosion

This being so the query naturally arises, why has erosion assumed such prominence of recent years? The indigenous inhabitants of erosion-prone lands are invariably aware of the dangers, at least subconsciously; were this not so they could not have survived, as they have done, fo thousands of years. The old bench terrace of the Mediterranean region, parts of the Far East, Peru and many other lands show that soil conservation has been practised from very early times. The traditional shifting cultivation of primitive peoples in their unmodified form provided safeguards and, even under such conditions, more advanced methods have become evolved in places. When, however, people of another race, unfamiliar with the effect of erosion, penetrate such lands and when primitive populations increase suddenly and rapidly under external influence, or when both occur together, difficulties usually arise.

The main root of the present situation is that all over the world, during the past 100 years, penetration of erosion-prone lands by northern races has been going on with unparalleled rapidity. Moreover, wars always lead to erosion, since military requirements usually cause the reckless sacrifice of forests and the neglect of ordinary precautions in cultivation, while military operations themselves may in a few hours destroy the labour of years.

The occurrence of two world wars in half a century has certainly contributed to the present position.

Conditions in the Colonies

As the Colonial Dependencies, with a few minor exceptions, lie in the tropics and subtropics, they fall into the erosion-prone category. Although some, notably the British West Indies, have been occupied by the British for several hundred years, and a few, like Cyprus, have a history of civilised occupation for several millennia, developments in the majority have occurred during the past 70 or 80 years. Prior to that they were for the most part sparsely inhabited by primitive peoples, practising simple forms of subsistence agriculture, usually shifting cultivation and nomadic grazing. Population and livestock increases were held in check by natural causes such as disease and famine and by inter-tribal warfare and slave raiding. Pressure on the land was rarely excessive and, although the level of subsistence was low, a stable position capable of indefinite continuance existed. With the advent of European influence this was changed. The introduction of law and order, combined with improved health conditions for men and beasts, alleviated these checks, entailing increases in the cultivated areas to support the greater population, while the demands in northern lands for tropical products led to further great extensions in the cultivated area, both as large plantations and also as native small holdings, usually with the active encouragement of the governments.

In the earlier years the dangers were unrecognised; usually no effort was made to modify existing cultural practices to suit the changed conditions, and extensive erosion was the result.

The position on estates

At the outset, methods used on estates were those of temperate countries; there was little appreciation of the peculiarities and dangers inherent in the tropical environment, and the result was widespread erosion. Nevertheless, although the position was very threatening at one time and still is serious in some places, it is not desperate. Intelligent management, the fact that estates consist of large blocks under single control, the existence of informed planting opinion and organised representation, and the facilities for financing improvements through land banks or government sources, all help to ensure that as soon as the dangers have become apparent and the need for, and efficacy of, conservation measures appreciated, they will be applied. This has already happened in the Far East and is occurring, albeit more slowly, in Africa.

The position on small holdings

The position in regard to peasant-owned small holdings is, however, different. Where there have been large extensions under peasant-grown permanent crops such as rubber, cocoa, coffee or coconuts, or where wet rice is the staple food, the threat is comparatively small; it has never been the habit of native cultivators to clean weed, and this, combined with the protection afforded by the crops themselves, provides safeguards, while the fact that wet rice requires that the land should be kept under water during the major part of its growth, automatically ensures that the soil also is conserved. It is where native agriculture is concerned with the cultivation of annual arable crops and extensive nomadic grazing that the position has become exceedingly grave and presents baffling problems, notably in large parts of tropical Africa and, to a lesser extent, the West Indies.

In Africa, extensive erosion has followed the shortening or abandonment of the bush fallows, traditional in native cultivation; in places the introduction of ploughing without adequate precautions also led to heavy erosion losses; on grazing lands, excessive concentrations of livestock and the absence of control over grazing occasioned extensive damage. The first step to a solution is often population transfer, or the absorption of part of the people in non-agricultural pursuits; an equally important step is the evolution and adoption of agricultural systems, modified to suit the changed conditions, which will lessen erosion risks and give higher yields. This is primarily an administrative problem, and is greatly complicated by the small size and scattered nature of the holdings, the prevailing low standards of education, land tenure conditions, tribal boundaries and treaty rights; also by customs and superstitutions as well as by economic and social considerations.

Soil conservation aims and methods

Soils vary in their erodibility; those with a low silica/sesquioxide ratio in the clay fraction are less erodible, and it is fortunate that many tropical soils show this character, otherwise erosion damage would be greater. But the chief factor is the structure of the soil, *i.e.* the degree of aggregation of the soil particles to form crumbs, well-aggregated soils showing marked erosion resistance. Under their natural vegetational cover, tropical soils have a well-marked crumb structure and, in its simplest aspect, erosion control largely depends on its maintenance. The aim of conservation is to check soil movement and to conserve fertility by (*a*) promoting the maximum absorption of rainfall and ensuring that surplus run-off flows slowly off the land and does not carry soil particles with it, (*b*) protecting the soil from the effect of high winds, and (*c*) maintaining the crumb structure of the soil.

Space prohibits details, but the various methods can be briefly classified as follows:

(1) Direct protective measures, including (*a*) the construction of terraces, protective drains and so forth, and (*b*) vegetative protection, including grass covers, contoured hedges and strips, wash stops, wind breaks and protective forests, all of which are intended to regulate the action of moving water and wind, and to promote maximum absorption of water by the soil.

(2) Agricultural methods, including contour ploughing, cultivation and planting, strip cropping, rotations, mulching, pasture management and control of livestock.

(3) General overall planning measures affecting the countryside as a whole.

(4) Administrative measures and legislation to ensure conservation.

There is a wide choice of agricultural methods and, in practice, the most suitable combination of treatments depends on the climate, the slope, exposure and character of the soil, as well as on the type of husbandry practised. There will be wide variations between those needed for annual crops in undulating, low-to-medium rainfall regions, permanent crops in mountainous, high-rainfall regions, and in open grazing areas. The layout and design of plantations and farms is also of importance. In any event, conservation must be integrated with farming practice and not regarded as a special *ad hoc* measure.

In general there is nowadays a tendency to rely increasingly on vegetative and cultural means of protection, although in some conditions the use of earth structures is unavoidable. In arable cultivation under medium to low rainfall, W. S. Martin and others in East Africa have shown that grasses promote soil crumb formation, and the alternation of grass leys with arable cultivation is probably the best basis for soil-conserving agricultural systems. But sound agricultural practices are only the commencement, since other factors are involved. The existence and maintenance of an adequate forest-cover at vital points is essential. The planning and siting of towns, villages and homesteads, the alignment and construction of roads and railways, the control of floodwaters of rivers, the regulation of mining operations and similar factors, all play their part. Economic con-

siderations such as land tenure, market prices, the availability of capital and marketing conditions also have a bearing on the matter. In its widest aspect, soil conservation must take account of all these factors; sound cultivation practices must be integrated into the agricultural system, applied to the whole countryside and effectively co-ordinated with other aspects into an overall plan of land use, supported where necessary by legislation.

The regional position

(*a*) **The Eastern Dependencies.** On rubber estates in Malaya the enormous losses formerly prevalent have largely been overcome. Planting on the contour, terracing and protective drains on hilly land, and the maintenance of natural or planted covers, are now general on rubber, oil palm and tea estates; opening new land, clearing along avenues and poisoning jungle trees, as opposed to burning, is also usual. Shifting cultivation, especially by Chinese, has always been and still is a source of trouble. It was aggravated during the Japanese occupation and continued after the close of the war. The emergency conditions have brought some hope of control since powers now exist for the removal of squatters and their resettlement. Prior to the war additional legislative measures were under consideration for checking erosion, and draft legislation had been prepared; unfortunately the matter has not been revived as yet.

Although it is no longer a colonial dependency, the position in Ceylon may be mentioned. It is in many ways parallel to Malaya, but as the country was mercifully spared the horrors of invasion and subsequent unrest, there have not been the same setbacks. Erosion on estates, at one time serious, has been largely checked, while considerable progress has been made in controlling it on peasant small holdings and in the regulation of shifting cultivation.

In Mauritius the main, if not the only, important crop is sugar cane, which is one of the least conducive to erosion; but the population is growing rapidly and is now in the region of 450,000 in an area of 720 square miles, or close on 650 per square mile; consequently erosion risks will probably increase. In the Aden Protectorate rainfall is low and cultivation depends on the use of flood water at times of heavy rain. Soil and water conservation are part of traditional practice, but serious erosion occurs where flood waters are not controlled, and wind erosion also may be serious. Agricultural staff is very limited, but some measures have been possible to improve matters. In the Seychelles,

Two examples of insipient gullying; the top picture was taken in the Gold Coast; the lower picture, taken in Nigeria, shows land which has been previously cultivated in yams

severe erosion has occurred on the sides of the steep mountain slopes, which in the past have been severely deforested without adequate alternative protection.

(*b*) **East and Central Africa.** On estates there has been of late years slow but sure progress in the application of conservation measures. In the past, advance has been handicapped by insufficient resources and by lack of knowledge and experience by planters; also by war. Much harm has been done by the continuous growing of crops such as maize and tobacco, which are highly conducive to erosion, without safeguards and without a break, but matters are improving. In Kenya, where the Soil Conservation Service of the Department of Agriculture under Mr. Colin Maher is specially concerned with conservation on estates, notable advances have been recorded. One handicap is lack of precise knowledge of the systems best suited to particular conditions. As Mr. Maher has remarked, one of the practical problems is ' what combination or sequence of fertilising, planting, organic manuring and construction of anti-erosion works is to be recommended to the farmer so that he can bring land into production at economic levels without excessive and disproportionate outlay ? '

In native areas the picture is different, although it varies greatly with conditions; In Uganda and parts of Tanganyika, as well as in the lowlands of the small and densely populated protectorates of Basutoland and Nyasaland, progress has been made with methods based usually on temporary grass covers, combined with simple cultural and protective measures, such as strip cropping on the contour, contour bunds and grass strips. On the other hand, in native areas with very dense populations, *e.g.* some of the Kenya reserves, the position is that soil conservation simply cannot be achieved without lowering population density. Furthermore, overcrowding, excessive land fragmentation, conservatism of the people, lethargy and apathy, lack of machinery and resources and active obstruction, frequently of a political nature, often make it difficult to carry out and execute conservation planning.

Taking an overall view, erosion on native lands in East Africa is serious and threatenning and, although in some places considerable progress with conservation has been made, it is at least doubtful whether erosion is yet on balance being effectively checked.

(*c*) **West Africa.** The situation differs from East Africa in that there are, with a few exceptions, no large estates, and the problem is one of erosion in native cultivation. The territories naturally subdivide themselves into a forest belt near the coast, followed by a savannah belt which gets increasingly arid as one proceeds northward, until on the confines of Nigeria it begins to approach desert conditions. In the forest belt permanent crops predominate, notably oil palms and cocoa, with arable cultivation and grazing in the savannah regions. Erosion in the forest belt is mainly confined to areas near towns and villages, but in the savannah belt the position resembles that in East Africa. In places where population pressure is heavy, *e.g.* in the eastern and part of the northern provinces of Nigeria and in parts of the northern territories of the Gold Coast, it is very serious. In the arid regions of the far north, wind erosion and drifting sand are serious features. The dangers were recognised later than in East Africa; measures to deal with the problem have now begun, but it is to be doubted whether they are anything like adequate as yet.

The problem is extremely difficult. In the eastern provinces of Nigeria, for example, an extremely heavy population is concentrated on acid sandy soils of low inherent fertility. Obstacles to the adoption of a soil conservation programme are the extremely complicated system of land tenure and the social structure of the people, over whom there is little authority and who resent interference with their freedom of action. It is easy to suggest ideal solutions such as population transfer and alternative occupations, but no complete solution can be offered unless the social systems can be modified.

(*d*) **The West Indies.** The story here is somewhat different inasmuch as development was originally almost exclusively in large estate properties, but with lapse of time the less productive have become fragmented into peasant holdings, while population increases have been going on apace. On sugar estates the crop itself and traditional planting practice have helped to check erosion. In Barbados, which supports a population exceeding 1,000 per square mile, with an erosion-resistant crop and a soil not very easily erodible, effective conservation has been maintained; if it had not, the population could not have survived. Elsewhere the introduction of erosion-conducive crops like cotton, and the spread of peasant agriculture has caused erosion to assume serious proportions in many islands, especially those which are mountainous. Where it has appeared on estates the problem is being tackled. In Jamaica many large estates have undertaken conservation measures in connection with bananas, citrus, cane and coconuts. Among native cultivators progress has been less, but some have been protected during the last two years. The situation in smaller islands is more or less similar; probably the greatest progress has occurred in St. Vincent. In British Guiana on the level coastal plain where the population is mainly concentrated and where most of the agricultural development has occurred, the crops being mainly sugar and rice, erosion is never likely to be serious.

(*e*) **The Mediterranean Dependencies.** Cyprus is an example of Mediterranean conditions where for thousands of years erosion has been a menace. Wars have played an important part throughout the ages. There has in the past been reckless sacrifice of forest, neglect or destruction of conservation works, bad cultivation and serious over-grazing, especially by goats. It is a country of low rainfall and steep hills and the prime need is to conserve water and soil. Since the British occupation in 1878, water storage for irrigation has figured prominently, and more recently the urgent need for soil conservation has become recognised. During the last war military requirements once more led to excessive timber cutting, doubtless unavoidable, but none the less unfortunate. Considerable efforts are in progress to improve matters, and a soil conservation section of the Department of Agriculture has been established, but once more the same difficulties recorded elsewhere are encountered. The system of land tenure and inheritance makes it difficult to organise large-scale conservation schemes, while no provision exists to enable conservation works to be carried out on private land without the owner's consent.

In Malta, survival has largely depended on conservation. In this small and densely populated territory every scrap of cultivable soil is jealously guarded; in fact, conservation is a part of the life of the people.

(*f*) **The Western Pacific Dependencies.** The position here is not yet very serious. In Fiji, sugar and coconuts, the main crops grown, are not erosion-conducive. High standards of cultivation are insisted on by the Colonial Sugar Refining Co. on cane farmers' land, while Fijian population density is not yet excessive. There are, however, evidences of erosion in peasant food-growing areas, and the position may presumably be expected to worsen as populations grow, unless effective control of land use is extended.

The overall picture and the outlook

There is fairly general awareness of the dangers, but whether the implications have been everywhere fully grasped is more doubtful. Some steps to counteract erosion have been taken in all dependencies; in many, soil conservation officers have been appointed; in Kenya soil conservation services have been established on some scale as a branch of the Agricultural Department, and in many colonies funds for conservation work have been provided from both colonial development funds and local exchequers. The chief dangers lie in the native areas and among small cultivators, and they indeed present disheartening difficult problems. The first requisite is often population transfer to lessen pressure on the land; coupled with this a revolution in existing agricultural methods is needed. Nor is this all, since effective conservation affects all aspects of rural life, involves overall regulation of land use and requires powers to enforce its observance. It is, of course, useless to attempt this unless there is widespread appreciation of the need for such measures and willingness to co-operate in them. The first need, therefore, is education of the communities to an appreciation of the dangers.

Experience among African and other communities shows that the problem is not hopeless, but so far little more than the fringes have been touched. Large tracts exist in Africa as yet untouched and uninhabited on account of the tsetse fly or for other reasons, and if these can be utilised they could provide room for expansion. But it is no easy task and involves the solution of many problems not merely agricultural, but also social, ethnographic, economic and administrative. It is of little avail transferring populations and then leaving them in their new surroundings to perpetuate practices which have assisted in bringing about the former difficulties. One hopeful feature is that in many parts of Africa communal ownership of land is traditional. On this account there is often predisposing willingness to collaborate in measures to protect the common heritage.

Need for basic information

A fundamental need is more exact information about the character of the soils, the climate and the vegetation. The information we have is quite inadequate. Hitherto the resources available have been incommensurate to the tasks. There is, moreover, need for research to elucidate the factors contributing to the varying erodibility of tropical soils and the all-important matter of soil crumb formation. There is not even any exact measurement of the rate at which erosion is occurring. On the social and agricultural side there is equal lack of information. Before the great changes needed can be brought about, sufficient knowledge on these aspects must also be available. It is only in its light that effective new agricultural systems can be worked out and put into practice. It is satisfactory that the need has been realised and that the Colonial Office, with the advice of its research committees and councils and the resources provided in part from Colonial Development and Research funds, is making great efforts to fill the gaps in the information, but it will take time and the need is pressing. One difficulty is the lack of adequate supplies of trained scientific manpower. Here it would be ungrateful not to mention the assistance and advice that has been forthcoming from the U.S.A. Economic Co-operation Administration.

Legislation

It may be asked what part legislation can play. The U.S.A. soil conservation laws, both state and federal, have

provided a pattern which is giving strikingly satisfactory results in that country and has been followed in South Africa, Australia and New Zealand. Somewhat similar legislation has been enacted in a number of dependencies, notably Nyasaland, Northern Rhodesia and Kenya. It is well adapted to developed communities, but its application to the more primitive native communities is usually not practicable without modification. The most appropriate channel here seems to be through native administrations or tribal authorities by means of tribal rules.

Co-ordination

An important need is co-ordination of the work of departments of the Government concerned with land use; lack of this has often given rise to difficulties, and the overall administration of these agencies through a development secretary, a policy which has been adopted in a number of African territories, seems a valuable step. An additional requirement is interterritorial and international collaboration, especially in Africa; it is satisfactory that international discussions have become increasingly frequent of late. The conference on conservation held in the Belgian Congo in 1948, and the more recent conferences in Nigeria, are cases in point, as is the UNO conference on the conservation of natural resources held last August.

Conclusion

The need for increased agricultural production in the colonial dependencies is obvious, but if this is to be achieved, the erosion problem must be overcome; this necessitates overall planning and controlled land use. There has hitherto been understandable reluctance to impose restrictions, particularly on native lands, while treaty rights and similar considerations at times act as barriers. But in time, perhaps not too far ahead, their absence may bring disaster. The need for them is increasingly recognised in many countries, including the U.S.A., many of the dominions of the British Commonwealth and a number of other countries. In the colonial dependencies, where rapidly declining fertility and erosion losses from improper land use are so great a threat, the need for far-reaching powers to enable the requisite degree of control over land use to be exercised seems inescapable. That is a brief and I fear incomplete outline of a vast subject. On the solution of the problems the future largely depends. There is no doubt that we possess the necessary technical knowledge, but it remains to be seen whether the many social, economic and administrative difficulties can be overcome.

Winter Hardiness

WINTER hardiness is the term given to a plant's resistance to any excessively low temperature that it may be likely to undergo; that is, the effect of temperature so low as to cause ice to form in the intracellular spaces, and the hardiness of any particular plant depends on the point to which this can go without causing physical or physiological damage.

At present the process of hardening plants is not fully understood, although much work has been, and is being done, to rectify this, notably by Russian scientists, to whom much of the literature on the subject must be credited. The United States and Great Britain, however, have also been doing research work in this direction.

Obstacles to be surmounted

The obstacles which the scientist is up against in trying to obtain winter hardiness are these: when the air temperature is below freezing point ice may be produced within plant tissues; this ice is formed by water extracted from the cell protoplasm, which in its turn is extracted from the cell vacuole; this brings about a higher concentration of cell sap. As more ice forms the protoplasm gradually dries out, transpiration proceeds and may be high if there is a dry wind, as is often the case in frosty weather. Now, if the soil water freezes, the plant can no longer absorb water by its roots and the whole plant will gradually decline; cells lose their turgidity and, in fact, wilting occurs. This is often not noticed until the plant thaws out and the ice turns to water. Similarly, as temperature falls respiration falls faster than photosynthesis, and so there is an accumulation of CO_2 reserves; this increases the formation of resistance by the production of more sugar, which strengthens osmotic pressure. Obviously this is only of use when the soil water is not frozen or the roots of the plant are below the frozen area.

It has been seen that photosynthesis is essential for the formation of resistance by supplying CO_2 to the plant, which can be converted into soluble carbonates and then sugars. Light is essential for this process, and if the plant is covered by snow, as may quite possibly be the case, it can no longer be carried out. CO_2 supply is reduced or completely stopped and thus the resistance of the plant is reduced. So it appears that the scientists have quite a lot to contend with in discovering a method of hardening.

The main object is to strengthen a plant's power to hold water and one method has been discovered for cereals at any rate. It is to expose the plant to a gradual fall in temperature in two stages. The first is to subject the cereal to a temperature of 6° to 0°C. for up to five days while photosynthesis takes place and sugar is accumulated. The next stage is to lower the temperature to —5°C. Ice is formed in the tissues, protoplasm is dehydrated and forms a protective association with the sugar; there is an increase in resistance and the cells can support greater pressure of ice without physical injury because the dry-matter content has been raised and the cells have more power to hold water against frost. Then when the thaw comes the plant tissues will not become waterlogged and rot because of the inability of cells to take the fluid back.

If this process is applied in the laboratory to several generations of a particular variety of cereal, it will become winter hardy, although to what extent it is difficult to predict. Of course, it would be preferable always to use naturally winter hardy varieties by virtue of their environment in particularly cold areas, but there is a snag—these varieties are invariably poor yielders.

Application of soluble salts

A subsidiary factor which may increase winter hardiness is the application of soluble salts to the soil (with the exception of nitrates, which tend to make plants softer if applied excessively), the object being to increase the specific gravity of the fluid drawn up by the plant so that its freezing point and its osmotic pressure will be raised as well.

It has been found that some parts of a plant are hardier than others; for instance, young leaves are hardier than old ones and leaf bases are hardier than leaf tips. Another observation is that very hardy plants have small cells; this presumably increases their turgidity. Again, the most winter hardy plants appear to be prostrate types; that is, their leaves are parallel to the ground when young. But this does not necessarily mean all prostrate types are winter hardy.

Conclusion

In conclusion, the methods explained for winter hardening only apply to those plants that form sugars. Whether they would be successful with woody plants that form oils is unknown. Hardening is *not* fully understood, but advances are slowly being made and perhaps the farmer will before long be able to sow his winter corn with confidence, come what may in the way of snow, frost and blizzard.

Oil and agriculture. A drilling derrick standing amidst the prairie corn, Montana, U.S.A.

Petroleum on the Farm

Propulsion, Protection and Inhibition

IT is convenient to consider the use of petroleum in agriculture under two main headings:

(1) Its use in the machinery introduced into agriculture.

(2) Its use as an agent in the growing of crops.

These were the subjects of a paper recently delivered before the Institute of Petroleum at Manchester by Mr. F. W. Ellis.

Petroleum and machinery

The use of machinery in agriculture practice in the U.K. has expanded very rapidly during the last ten years, but its full history covers a much longer period. It dates back to 1856 when John Fowler perfected his first steam ploughing outfit.

There is, indeed, much confusion between agricultural engineering, which is concerned with the manufacture, development and testing of machinery, and its sister subject, farm mechanisation, which is primarily a problem of farm management.

While the two subjects go hand in hand, agricultural engineering has had a very much greater proportion of brain power and finance devoted to it than has farm mechanisation. It is only through the study of farm mechanisation that the place of each machine and its proper utilisation on the farm can be assessed, and to date comparatively little useful work in this field has been done.

Petroleum and tractors

We have not yet learned in Great Britain to use a tractor to anywhere near its potential capacity, whereas on the small family North American farm the tractor is regarded as a maid of all work and its power, via pulley or power take-off shaft, is exploited to a much greater extent. Hoists, saws, concrete mixers and many other jobs are all powered through the tractor, and this tendency is bound to increase in the U.K. when the evils of over-capitalisation on expensive machinery come to be fully realised.

A recent survey of tractor operations made by economists of the University of Nottingham shows that in the cases they examined the number of hours worked per tractor per year varied between 341 and 2,363, whilst the average for the country as a whole is rather less than 1,000 hours which, allowing for 300 working days, means a little over three hours work per day.

In the U.K. the total number of tractors of all types is now approaching 300,000. It is not anticipated that the rate of increase will continue at the level of the immediate post-war years, and it is probable that the figure of 300,000 represents a peak unless some other unforeseen factor intervenes.

The best estimate that can be made at the moment indicates that there are some 50,000 petrol tractors, 15,000 diesel tractors and 230,000 kerosene tractors, which in turn are responsible for the consumption of 25 million gal. of petrol, 12 million gal. of diesel fuel and 225 million gal. of vaporising oil.

Diesel tractors

A factor which will undoubtedly greatly influence sales of tractor fuels in the next few years is the increase in diesel-engined tractors. In the U.K. diesel tractors have not been accepted so widely nor so quickly as in most other countries. The main reason is that the manufacturing cost of a diesel-powered unit in the U.K. is still very high as compared with that for a kerosene or petrol engine. One popular make of tractor today which can be fitted either with vaporising oil or a four-cylindered diesel engine is scheduled to cost £197 10s. more when fitted with the diesel unit. The difference with some other makes is even greater especially where a four-cylinder petrol engine is replaced by a six-cylinder diesel unit. There is no doubt that such an increase in initial cost is a very potent factor in retarding the rapid introduction of the diesel engine to British agriculture.

However, in spite of this, the numbers are increasing, particularly in the mainly arable districts down the eastern side of the country. It may also be that the Government sponsored plan to reclaim a large amount of marginal land on the lower hills will call for an increase in the heavier

types of tractor, many of which would be diesel-powered.

Apart from the high manufacturing cost, there is much to be said from a technical point of view in favour of a tractor driven by a diesel unit. The three main advantages are:

(1) The running cost and fuel consumption are low.

(2) From the point of view of both maintenance costs and reliability, the diesel is attractive, particularly so in an industry where many machines have to be operated by workers who are comparatively unskilled in engineering, although well trained in other parts of the job.

(3) The high torque at low-engine revolutions makes it an ideal power unit in land work. It may be compared with the ox, which is still the best-known animal power unit in the world for the basic job of ploughing.

Fuel for driers

The use of fuel oils for artificial drying of crop products has come to the fore very much during recent years.

Drying in agriculture can be broadly divided into two categories: (1) grain drying and (2) crop, or as it is generally known, grass drying.

Grain drying is complimentary to the introduction of the combined harvester and there is no doubt that the combined harvester is here to stay. There were last year over 11,000 combines at work in the U.K., and the numbers are increasing rapidly. When corn is harvested and stacked in the traditional manner, there is no need for artificial drying, but grain, harvested from the field either in bulk or in sacks in this country, generally needs to be dried before it can be stored safely. A moisture content of about 14% is usually considered to be the safe maximum, but it is quite common for grain from the field to contain 22 to 23% of moisture.

Crop or grass drying is now an established feature of the industry and there are between 500 and 600 driers now in operation. A reasonable estimate is that this number will increase to about 1,000 by the end of 1952.

In practice there are three main types of drying organisation: (1) the drier on the farm which supplies mainly food for the stock kept on that farm; (2) the co-operative drier serving a group of farms in the area and administered by some official body or farmers' co-operative; and (3) the factory type of drier which produces stock food for sale to farmers or to the feeding stuffs industry. The size of driers varies enormously, but by considering only the smallest type—the farm drier—some kind of an estimate for fuel consumption can be arrived at. The farm drier producing 300 tons of material during a year and using 50 gal. of oil fuel per ton to do it will be responsible for a consumption of some 15,000 gal. If it is assumed that at present 350 plants are running on oil fuel then there is a consumption of over 5,000,000 gal. per annum.

A noteworthy point is the rapidly increasing interest in the use of medium fuel oil which comes into the viscosity category of 200 seconds at 100°F. Generally speaking, grass drying is a costly process, and farmers and others operating drying plants are therefore in the mood to seize eagerly a chance to reduce their production costs by the use of these heavier grades. On technical grounds there does not seem to be any serious drawback to the use of 200 seconds fuel for crop drying.

The future of crop drying in agriculture is by no means certain. At the present time, with purchased feeding stuffs for dairy cattle costing between £28 and £30 per ton even before the recent removal of the £26,000,000 subsidy, there is every encouragement to produce dried grass for less than half that figure, and there is little doubt that for the next few years there will be an increase in drying plants. At the same time, however, the preservation of grass and other crops by ensiling is making very rapid strides. It is a much less costly process and may eventually over-shadow the development of drying.

While it is not known exactly how many of the established drying plants are running on solid fuel and how many on oil, the advantages of oil fuelling are considerable and it is reasonably estimated that some 60% of all the driers in use are oil-fired. It is also true that the majority of new plants are now being installed to run on liquid fuel.

Lubricants, greases and rust preventatives

The use of detergent oils for the growing numbers of diesel tractors is one which will need a good deal of attention. While the case for using detergent oils is fairly clear, diesel tractor drivers who have been running their machines on straight mineral oils and then changed to detergent oils have experienced some trouble through the loosening of deposits and carbon which are then freed to circulate in the system. These problems are well understood, but with the sale of detergent oils for tractors there must be adequate technical advice on their correct use, particularly at the period of change-over from straight mineral oils to detergent oils.

Among operators of farm equipment far too little still is known about greases. The modern tractor and much agricultural machinery is precision-built and it is still quite common to find one general-purpose grease being used for water-pump glands, track rollers and other parts which have specific requirements not covered by general-purpose greases.

There has also been some trouble with drying plants. For instance, the fan bearings on a grass drier deal with air and flue gases at 300 to 350°F. and some of the pneumatic-type driers operate at temperatures up to 2,000°F. It is obvious that special high-temperature lubricants are required, and technical guidance on their use imperative.

There has also been wide acceptance among farmers of the petroleum-based rust preventatives, but once again results in some cases have been somewhat disappointing. Generally speaking, the petroleum-based preventatives can do and are doing a useful job in the preservation of all types of farm machinery, but they are still apt to be regarded by some as rust removers. Some particularly difficult problems have not yet been solved, one of which is the adequate protection of machinery handling fertilisers. Some of the products available are useful to a certain degree for this application, but the corrosive effect of acid fertilisers is still one of the greatest sources of damage to agricultural machinery. A suitable softening agent would meet with immediate acceptance, as would also an efficient rust-removing preparation.

A balance has to be struck between the erection of expensive cover for machines and expensive labour to care for them and their depreciated book value in the year's accounts. It is clear that with the advent of larger, more costly self-propelled machines such as combined harvesters and pick-up balers (whose initial purchase price may well be over £1,000), there is every reason why proper cover and proper detailed maintenance should be regularly carried out.

Other uses for petroleum in crop production

Apart from its employment in connection with machinery, petroleum finds a wide range of other uses in agriculture. Examples are the use of petroleum white oils in insecticidal orchard and greenhouse sprays. Generally, its action is to destroy the eggs of the insects or to act as a contact insecticide which clogs up the breathing apparatus of the insect concerned. In some cases, however, there may be a dual toxic effect as well.

Another established use for petroleum is as a weed killer. It has long been known that most petroleum oils are phytocidal to a greater or lesser degree and, where a complete kill is required of a green cover, *i.e.* on permanent way, paths, etc., spraying with the lighter distilled grades of petroleum is already widely practised. The same technique for destroying weeds in citrus fruit orchards and vineries is widely employed in California and elsewhere.

A more interesting application lies in its use as a selective weed killer. The most outstanding success in this regard having been achieved with carrots and related crops.

The natural order of plants known as Umbelliferae, to which carrots belong, evinces a certain resistance to the phytocidal effects of petroleum. This natural order unites crops of economic importance and also a number of weeds, but it so happens that the majority of the economic crops of this family are not grown in situations where the weed members of the family are a serious menace. Consequently, certain types of petroleum can be used as a spray to kill the weeds and leave the planted crop unharmed. The actual biological action of the oil is not completely understood, but it appears that it may be in some way tied up with small quantities of aromatic compounds present in the oil. It does not appear to be co-related with the content of aromatics, as assessed by normal methods and, in fact, the problem is a good deal more complicated than was originally anticipated. Research work on this point is in progress in various parts of the world.

The work resolves itself into two main phases:

(1) Examination of the various petroleum fractions to ascertain which particular compounds have a phytocidal or toxic action on the plant; and

(2) Investigating the action of those fractions on the plant tissues themselves.

The two products which have received the widest application for this particular purpose are vaporising oil with its high aromatic content and white spirit, which is now accepted in many parts of the U.S.A. as a standard spray for the carrot crop.

Another channel along which developments are indicated is the use of petroleum as a carrier for other active phytocidal agents. It takes some 400 to 500 gal. of spray to treat an orchard and the greater part of this is water. Water is heavy and expensive to transport and, accordingly, sprays, in which water as a carrier is replaced by petroleum, can be used at much smaller gallonages per acre because of the greater covering and spreading effect. This seems to offer a possible cost reduction which might have far-reaching effects on spraying programmes.

Petroleum oils can also be atomised in a stream of fast-moving air and various techniques for their use in this form are at present under investigation. In such cases, however, the petroleum is merely the carrier, the active agent being some other chemical and, accordingly, the type of oil used must be biologically inert.

A third line of development is the use of petroleum as a synergist. A synergist is an agent which, through its presence, increases the potency or effectiveness of some other chemical agent. Certain forms of petroleum have been found to synergise the chemical hormone weed killers and their use in this direction may be expected to expand.

Conclusion

Undoubtedly the first problem of the petroleum industry is that of supplying to the workers in agriculture the essential technical information to enable the products to be correctly applied, handled and stored. There is a vast amount of missionary work to be done here, and it is an encouraging sign that some of the distributing companies are going to considerable lengths to deal with the problem.

The second problem is the need for close study of the actual conditions under which petroleum products are used in farm machinery—with liaison between manufacturers on the subject of lubricating devices. The open oil hole still appears all too frequently and there are many machines with bearings working in mud and dust on which there is no means of excluding either.

In the field of petroleum as an agent in growing a crop, there must be a narrowing of the gap between the petroleum technologist and the various classes of biologists, without which no real progress can be made. It is perhaps surprising that up to the moment there is no published material dealing with investigations into the effect of petroleum on the soil itself, although it is only fair to say that the indications are that no harm is caused and in some cases an improvement is effected.

[*Photo on p. 310 by Esso*

Orchard Expansion in Southern Rhodesia

Efforts are being made to make Southern Rhodesia self-supporting in regard to deciduous fruit, with a possibility of surplus for export.

In the past fruit growing has been very much a domestic affair and growing for commercial purposes has not been undertaken to any great extent. Orchards were planted many years ago on the Rhodes Inyanga Estate (in the north-eastern part of the Colony), but they did not receive sufficient attention and production was limited, while many trees became infested with disease.

Last year an orcharding programme was started. The trees were pruned and sprayed and bad specimens uprooted. Already there have been excellent crops, and this year's yield of Ohenimuri apples is outstanding.

There are exceptional opportunities for fruit growing in Southern Rhodesia because of the wide range of temperatures and conditions. Both temperate and sub-tropical fruits can be raised and the possibilities of expansion are considerable. The object at Inyanga is to establish a research station rather than a commercial fruit-growing proposition, but the results of the research will be at the service of private growers and a considerable number of commercial orchards should be established in consequence.

The Colonial Touring Exhibit

As a sequel to the Colonial Exhibition staged in London last year by the Colonial Office and the Central Office of Information as part of Colonial Month (reviewed in these columns in our first issue), a tabloid version of the display has been organised by the same authorities, and is at present touring eight of the largest provincial centres in the United Kingdom.

The exhibit was on show for two days at the Imperial Institute and subsequently opened its doors during May in Southampton. It will in turn subsequently visit Bristol, Cardiff, Liverpool, Glasgow, Newcastle-on-Tyne, Birmingham and Bradford. The whole tour will last nine months and will serve as a prelude to its exhibition at the Festival of Britain next May. In connection with it arrangements are being made for holding Colonial Weeks in each of the centres, coincidentally with the visit of the exhibit.

The exhibit itself, although smaller than that staged in London, is of the same type and in some respects represents an improvement on it since the balance between the various aspects of colonial life and industry is better preserved. As with the London show a prominent feature is life-size representations of certain colonial native types. It is hoped that the exhibits will dispel some of the ignorance of Colonial matters in the U.K.

FARM MACHINERY

New Mobile Grass Drier

For some time Tiltman Langley Laboratories Ltd. has studied the possibility of applying gas turbine technology to industry, and this led to the design and development of a new type of grass drier.

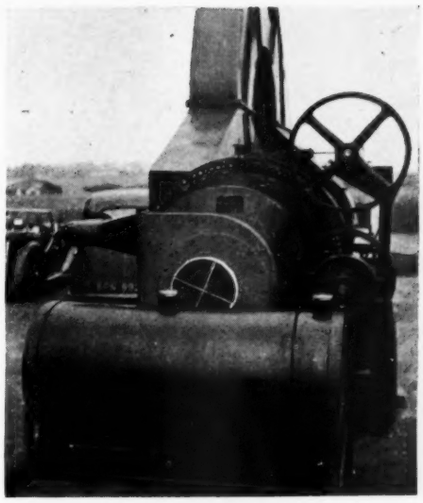
The grass drier employs a burner of the type used in aircraft gas turbine engines. A thin layer of grass is dried in a rotating drum, the warm air being circulated in a closed circuit by means of a fan. A small amount of the moist air is expelled and replaced by the fresh air used for combustion.

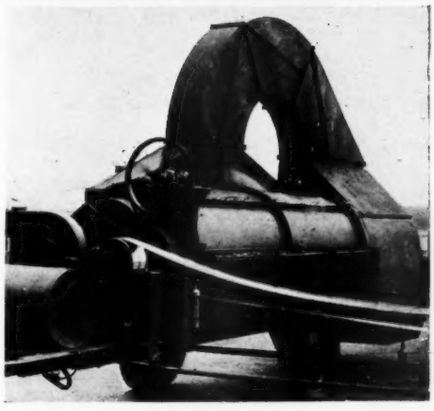
Many large grass driers, with a capacity up to 5 tons a day, are already in production and use, catering for farms of 1,000 acres or more, or being operated by smaller farms on a co-operative basis. These driers are expensive to buy and install and they are beyond the reach of most of the 100,000 small farmers in England. The company therefore decided to concentrate on the production of a small, mobile drier which would meet the requirements and pockets of the farmer with from 25 to 200 acres. The drier so produced is small enough to be moved about by means of a tractor and it can be driven either by the pulley take-off of the tractor or by a separate engine.

When a farmer decides that a field is ready for cutting, he places the drier in one corner. He then starts cutting with a cut-lift and waggon from which he loads up the drier with wet grass while he starts cutting the next load. Each load, weighing about 2½ cwt., takes about 45 minutes to dry and yields 0.5 cwt. of dried grass, which is bagged and carted back to the farm buildings for storage. This method effects a considerable saving in time and transport compared with hauling loads of wet grass back to a static drier at the farm, which may be anything up to two miles away.

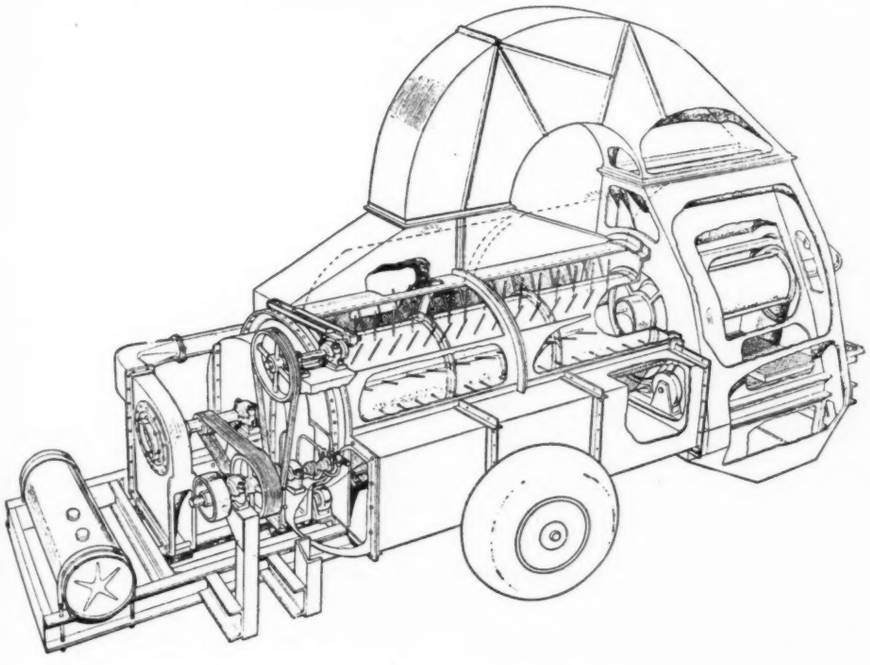
It is claimed that grass drying and silage making will eventually eliminate haymaking as it has been known for centuries, for it has been found that four or five cuts can be made from one field in a year, and an average value of 15% protein may be expected.

The diagram shows the operation of the drier in detail. The inner drum is rotated at 1 r.p.m. by a suitable drive from the layshaft. Grass is fed into the top through the loading door from a farm trailer. The grass is carried round by means of tines between the inner and outer drums. Hot air from the burner is drawn through the centre of the rotating drum by the large fan and is discharged into a duct which runs the full length of the fixed outer drum. It then passes through a screen and flows around each side of the rotating drum, drying the grass on its way. It is discharged through a screen into the trunking, carrying with it small particles of dried grass which are deposited into the hopper. The wet air then passses through a fine screen to mix again with the hot air round the burner. The dried grass itself is unloaded on to the ground through the unloading door, after which it can be bagged, together, with the fine particles from the hopper. The burner can be controlled to give low, medium and high quantities of hot air.





Above: **End view of Tiltman Langley grass drier, showing blowers and oil tank, and below it the side view. Picture below shows cutaway view of the drier**



The grass drier can be modified for use as a grain drier by fitting an adaptor-trunking to the outlet of the large fan and connecting it to a flexible hose, which has several rigid tubes branching from it for inserting in the grain sacks. For grain drying the burner is adjusted to the low setting.

It is also proposed to produce the burner and fan as a unit for grain drying only.

To meet a need that has been expressed by farmers, the company has developed a light, portable shed. Its dimensions are: length 15 ft., width 10 ft., height 8 ft. in front, decreasing to 7 ft. at the rear. The shed consists of six prefabricated units—two side panels, two back panels and two roof panels—weighing less than 130 lb., which means they can be easily manoeuvred by two men, stowed in a wagon for transport and assembled.

Left: **The 'Rapidcut' in action clearing scrub at ground level.** *Right:* **Remaining stumps after felling a hedge which had been neglected for 43 years**

The 'Rapidcut' Machine

Two new models of the 'Rapidcut' machine which can be used for land reclamation, tree felling, scrub clearing, hedge cutting, etc., will be displayed at the Royal Show, to be held at Oxford, July 4-7.

An entirely new design for the Ferguson tractor will be displayed in addition to the Fordson model.

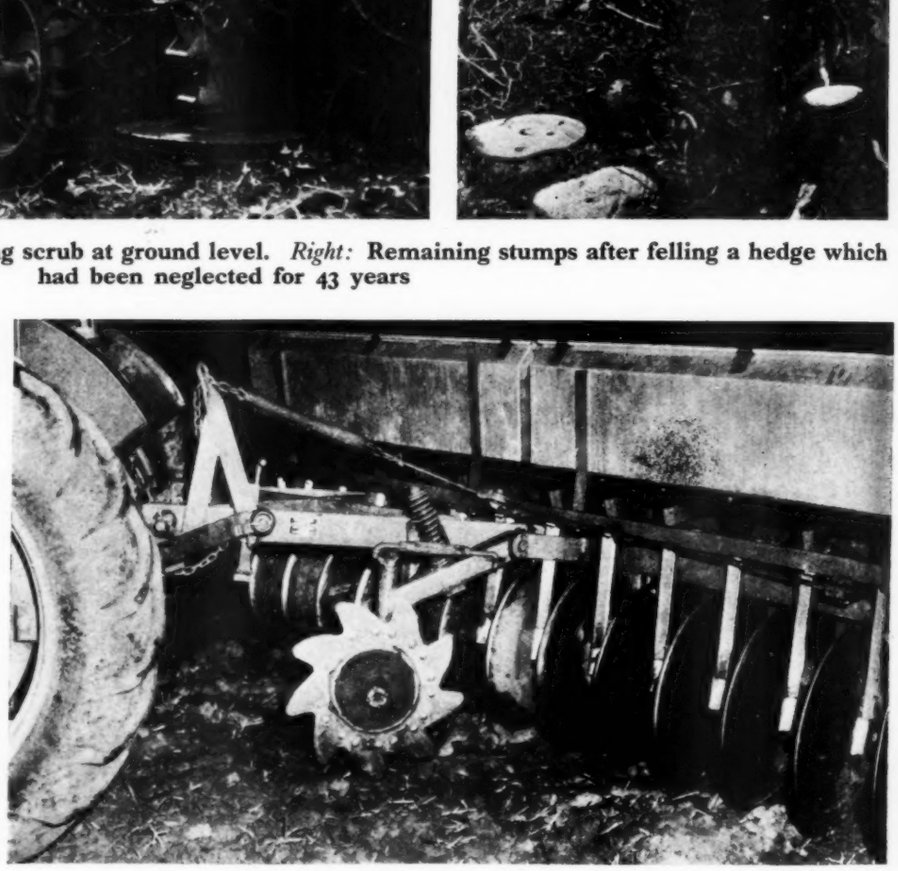
In response to a demand for this machine by agents overseas, the manufacturers have incorporated several new features in the design to increase its versatility for hedge cutting, tree felling, scrub clearing, sugar cane cutting, etc.

Both new models are fitted with a power-operated winch controlled by a small lever for regulating the height of the cutting blade while the tractor is in motion.

The original lattice-type jib has now been superseded by one incorporating a single steel tube, giving a reduction in weight and much greater strength and rigidity. These jibs are quickly interchangeable and three different lengths are available for Fordson models.

An interchangeable, bevel-geared driving head will meet the case where a greater range of angular adjustment for the cutting blade is required, for the purpose of cutting and felling in a horizontal plane at heights up to 9 ft.

A 40-in. diameter 94-tooth saw blade is supplied for tree felling, scrub clearing, etc., and a 42-in. diameter four-cutter blade for hedge-cutting and trimming.



Canada's One-Way Disc Plough

Agricultural engineering firms in Canada have been designing and testing implements for special use with the Fordson tractor, which are suitable for Canadian conditions.

The implement illustrated above is a one-way disc plough with seeder box, fitted with a special rolling type steering fin. The discs are 22 in. in diameter and the implement fits the Major's linkage and is lifted by the hydraulic power lift. This equipment is used to plough the land and drill in one operation, working to a maximum depth of between 5 in. and 6 in. and cutting a total width of 9 ft. at one sweep.

U.K. Machinery Increases

Without exception, all horse-drawn implements have declined in number while the majority of other implements have increased in England and Wales during the last two years. This is seen from the agricultural machinery census figures which have now been given by the Ministry of Agriculture, as a result of a census taken this year and compared with equivalent figures for 1948.

The numbers of agricultural tractors have increased by 26% and horticultural tractors by 39% over 1948. There are 50% more tractor trailers, but 12.8% less waggons and carts. Similarly, horse ploughs have decreased by 37% and

tractor ploughs increased by nearly **23%**.

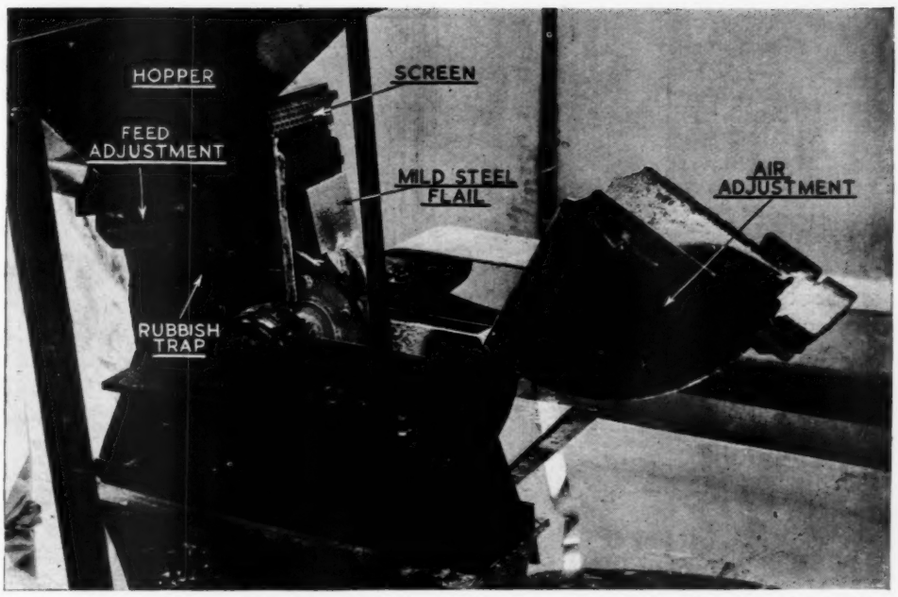
There has been a surprising increase in tractor hoes, which have more than doubled from 18,780 to 40,290. Potato planters are gradually gaining favour and their numbers have increased from 7,120 to 10,970 during the last two years.

From the figures for harvesting machinery the decline of the horse is particularly noticeable in connection with mowers; horse-drawn mowers have declined 20.4%, while tractor-drawn ones have increased by 61.1%.

Combined harvesters have more than doubled, which was to be expected, as deliveries have only speeded up during the last year or so. Complete sugar-beet harvesters have also increased greatly, from 230 to 840, although the total number is still small; the beet acreage this year is forecast at 393,000. Similarly, the number of grass driers, although more than doubled, remains relatively small for a grassland country. Pick-up balers are becoming more widely used and their numbers are increasing more than stationary balers—an indication of the increasing mechanisation of haymaking. They are also being used more commonly in conjunction with combined harvesters.

In the table below some of the figures from this year's census are compared with those of 1948 and the percentage increase or decrease shown at the side:

Machine or implement	*Number January 1948*	*Number January 1950*	*% change*
POWER AND HAULAGE:			
Total agricultural tractors	205,080	258,870	+ 26.2
Total horticultural tractors	26,200	36,400	+ 39.0
Waggons and carts	463,370	403,930	- 12.8
Tractor trailers	146,680	221,070	+ 50.7
Power fruit sprayers	6,610	8,030	+ 21.5
Wheeled and tractor-mounted ground crop sprayers	3,280	4,190	+ 27.7
TILLAGE AND CULTIVATION:			
Mould-board ploughs—Horse: 1, 2 or 3 furrow	171,180	137,880	- 37.0
,, ,, ,, —Tractor	214,510	263,670	+ 22.9
Ridging ploughs—Horse	108,580	95,950	- 11.6
,, ,, Tractor	35,560	63,100	+ 77.4
Cultivators, grubbers or scufflers—Horse	108,580	95,950	- 11.6
,, ,, ,, —Tractor	100,710	139,830	+ 38.8
SOWING AND FERTILISER DISTRIBUTING:			
Corn drills	89,810	91,340	+ 1.7
Combined seed and fertiliser drills	19,680	23,880	+ 21.3
Root drills	84,640	87,170	+ 2.9
Fertiliser distributors over 5-ft. wide	74,830	88,450	+ 18.2
Potato planters	7,120	10,970	+ 53.9
Seedling transplanters	4,060	5,260	+ 29.1
HARVESTING:			
Mowers over 3 ft. wide—Horse	135,190	107,620	- 20.4
,, ,, ,, ,, —Tractor	66,710	107,490	+ 61.1
Binders	119 080	120,220	+ 0.9
Combined harvester-threshers	4,970	10,120	+103.8
Green crop loaders	1,000	4,100	+310.0
Silage cutters and blowers	1,050	1,220	+ 16.1
Potato spinners	52,340	59,610	+ 13.6
Complete sugar-beet harvesters (combined topper, lifter and cleaner)	230	840	+265.0
BARN AND FARMYARD:			
Hay and straw balers—Stationary	5,800	7,280	+ 25 5
,, ,, ,, ,, —Pick-up	1,820	5,020	+175.8
Grass driers	320	660	+106.3
Grain driers	1,130	1,310	+ 15.9



The new Jeketo hammer mill with the casing opened up, showing the simplicity of design

Swiss Tractor Spare Imports

The Swiss authorities have decided to place the import of tractor spare parts on a quota basis. Hitherto, these could only be brought into the country against a special permit. Imports of complete tractors have been subject to quotas for several years now.

New Flail-Type Hammer Mill

The Emerald Welding Co., of London, are now manufacturing a new flail-type 'Jeketo' hammer mill, which combines simplicity of design and economy of price, in an effective machine for grinding all types of grain, beans and peas into a variety of sizes.

Grain is fed by gravity and suction from a double capacity hopper, holding 2 cwt., into the mill, which rotates at 2,500 r.p.m. There are five mild steel flails which, besides grinding, act as a fan and suck in the grain with the air-stream that they cause; any foreign matter, stones, etc., fall through the air-stream into a rubbish trap before they can enter the mill. The suction can be increased or reduced by means of a sliding hatch and the rate at which grain leaves the hopper is regulated by a shutter.

The machine is supplied with a $\frac{1}{4}$ in., $\frac{3}{16}$ in. and $\frac{1}{8}$ in. screen and there is also a $\frac{1}{16}$ in. screen for fine work; these screens are easily interchanged by sliding them in and out of position.

The milling process is practically dustless, as back-pressure from the flails blows dust into whichever of the two bags on the detachable bagging spouts is not being filled with milled material.

The performance of the mill, when using a fine screen of $\frac{1}{16}$ in. is about 3 cwt./hr.; when using a $\frac{1}{8}$ in. screen it is about 5 cwt./hr., and with a $\frac{1}{4}$ in. screen nearly 7 cwt./hr. is ground.

The mill can be driven from a tractor or any other suitable power unit.

WORLD CROP REPORTS

European beet area

The estimated increase of sugar beet in Europe, excluding the U.S.S.R., compared with 1948-49, is 5½%. Yields were, however, very poor last season due to drought, and the possibility of a higher increase in sugar output must be allowed. The following table, from Czarnikow's *Sugar Review*, shows estimates of the European beet area for 1950-51, with comparative figures for last year's campaign:

Hectares	1950-51(*a*)	1949-50
Germany	382,000	350,501
Danzig	—	—
Austria	26,400	26,000
Czechoslovakia	210,000	193,303
Hungary	115,000	113,079
France (*b*)	315,000	314,246
Belgium	62,000	58,695
Holland	65,000	67,476
Denmark	68,700	62,395
Sweden	50,000	48,800
Poland	265,000	260,000
Italy	160,000	132,000
Spain	90,000	92,000
Slovakia	—	—
Yugoslavia	60,000	47,000
Roumania	65,000	62,000
Bulgaria	30,000	30,690
Switzerland	5,700	5,430
Great Britain	166,000	163,015
Eire	26,000	22,500
Finland	8,500	7,167
Latvia	—	—
Lithuania	—	—
Turkey	53,300	51,209
Europe, excluding Russia	2,223,600	2,107,506
Russia	1,155,000	1,153,395
Europe, including Russia	3,378,600	3,260,901

(*a*) Estimate.
(*b*) Beet area for sugar production.

Ceylon's tea production

In 1949 Ceylon produced 298.5 million lb. of tea and exported 297.6 million lb., well over a third of this going to the United Kingdom. These figures compare with the pre-war average of 231.5 million lb. production, and 221.6 million lb. exported.

The second leading market for Ceylon tea exports was Australia, importing 33.8 million lb., compared with 26.4 million lb. to the United States. Ceylon also sent shipments of tea to Egypt, Union of South Africa, Canada and New Zealand.

The important question confronting the Ceylon tea industry is whether there is to be a bulk purchase contract for 1950 with the United Kingdom's Ministry of Food. The Ceylon trade feels that past contracts have given firmness and stability to the Colombo tea market.

Fall in U.S. winter wheat production

The U.S. Department of Agriculture estimates the probable crop of domestic winter wheat at 689.6 million bushels in May, against 763.6 million estimated in April and 884.7 million estimated in December last.

This indicates a substantial fall in production matched against the crops of the two previous seasons, that for 1949 having totalled 901.7 million, while the 1948 crop reached 1,007.9 million. The 10-year average (1938-47) worked out at 726.6 million bushels.

With only average yields in the spring wheat areas, production of all wheat may fall below 1,000 million bushels for the first time in seven years.

South African cotton

The 1949-50 cotton crop, now being picked in the Union of South Africa, is expected to reach a near record of 16,000 bales (of 500 lb. gross) from a planted area of 32,000 acres, compared with estimates of 4,000 bales and 8,000 acres in 1948-49. The sharp increase is attributed to higher prices stimulated by a rapidly expanding domestic spinning industry and to the recent development of a variety that is resistant to the jassid pest. Yields of about half a bale per acre were normal, but heavier yields were in prospect until damage was sustained from drought and bollworm attack.

Dutch wheat and barley

This year's wheat area in Holland has fallen from 250,000 acres to 220,000, while the barley acreage has risen from 100,000 acres to 175,000 as farmers are growing more barley for feed. An average wheat yield is expected and wheat imports for 1950 are estimated to reach about 700,000 tons, including 625,000 tons under the International Wheat Agreement.

Swedish sugar beet increase

The sugar beet acreage in Sweden is expected to increase by 9% this year to 53,400 hectares, as against 48,850 hectares last year.

Despite the increase, enough sugar beets will not be grown to employ the full capacity of the Swedish sugar industry. Nor will they be enough to meet Sweden's needs.

Record Malayan rice crop expected

It has been officially stated by the Acting Director of Agriculture, Federation of Malaya, Dr. A. E. S. McIntosh, that the present padi season gives every indication of being a record one in the history of Malaya. A preliminary forecast, based on estimates from state and settlement agricultural officers, shows that rice production for 1949-50 will probably exceed 400,000 tons, as compared with 307,180 tons in the 1948-49 season.

The principal reasons for this promising crop are the excellent weather that has so far prevailed, particularly in the important rice-growing state of Kedah, and the exceptionally high average yield that is expected. Kedah, which accounts for about one-third of the area under padi in Malaya, anticipates the high average yield of 400 gantangs per acre (a gantang padi = 5 lb. approximately), the highest average yield yet recorded. This compares with 210 gantangs per acre last season, when the crop suffered severely from drought, over 41,000 acres being completely destroyed. The state of Perlis also expects a high average yield of 338 gantangs per acre as against 207 gantangs in the previous season. Another large increase in yield is expected in Penang and Province Wellesley, with 292 gantangs per acre as compared with 183 gantangs in 1948-49. It is at present estimated that the overall average yield for the Federation will be 309 gantangs per acre, an increase of 67 gantangs per acre over the average yield in 1948-49.

Malaya's record rice harvest prospects are also noted in the latest annual report on the world food situation published by the United States Department of Agriculture. The report records a 'significant improvement during 1949 in the overall food situation of the Far East.' Rice production in 1949-50 in the area as a whole, however, is put at about 3% lower than in the previous season.

Sugar

In recent World Crop Reports the items 'U.K. sugar imports and exports, 1949' (May issue) and 'B.W.I. sugar estimates' (June issue) were reproduced from *Sugar* by courtesy of C. Czarnikow, Ltd.

Correction

In the June issue of WORLD CROPS the caption to the last illustration of the article entitled 'The Palm Oil Industry of Indonesia,' which appears on p. 248, should read 'Oil is extracted from the *pulp* by hydraulic pressure.'